MOTOROLA
Communications and
Electronics Inc.

NST
NATIONAL
SERVICE
TRAINING

TRUNKED CENTRAL CONTROLLER

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TRUNKED
CENTRAL
CONTROLLER

COURSE HANDOUT

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TABLE OF CONTENTS

FRONT - Course Outline, Glossary, and acronyms

I. Trunking Concepts and Signalling

II. Options

III. Labs/Troubleshooting

IV. Manuals

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TRUNKED CENTRAL CONTROLLER and REPEATER CONTROL CIRCUITRY
Course Outline

Tab I Trunking Concepts and Signalling

TRUNKING INTRODUCTION

I. Trunking definition

II. Loading Criteria

III. System Central Controller

- A. Control Tasks
- B. Receive Tasks
- C. Transmit Tasks
- D. System Central Controller Programming

IV. Base Station Repeaters

- A. Description
- B. Ratings
- C. Frequency Assignment
- D. Types of Assignment

V. Subscriber Units

- A. Definition
- B. Simplified Operation
- C. Code Plug Contents
- D. Trunking Logic Circuitry

Quiz #1

VI. **System Capabilities**

- A. Types of Trunking
  - 1. Transmission Trunking
  - 2. Message Trunking
- B. Types of Call Capabilities
  - 1. System Call
  - 2. Fleetwide Calls
  - 3. Subfleet Call
  - 4. Multiple Subfleet Select

- VII. System Reliability Features
    - A. Multiple Channels
    - B. Back up control channels
    - C. Receiver Interference
    - D. Transmitter power failure and SWR shutdown
    - E. System self-diagnostics
    - F. System Time Outs
    - G. System Alarm Reporting
    - H. Misdirected Radio Protection
    - I. Continuous Assignment Updating
    - J. Failsoft
- VIII. System Access Features
    - A. Talk Prohibit Tones
    - B. Talk Permit
    - C. Automatic Retry
    - D. Multiple Priority Levels
    - E. Recent User Priority
- IX. **Trunked System Signalling**
    - A. Outbound Signalling Words (OSWs)
    - B. Inbound Signalling Words (ISWs)
- X. Fleet Mapping
- XI. Board Functional Descriptions
    - A. Central Site Controller Board (CSC)
    - B. Receiver Site Controller Board (RSC)
    - C. Inbound Recovery Board (IRB)
    - D. Receiver Interface Board (RIB)
    - E. Transmitter Site Controller Board (TSC)
    - F. Transmitter Interface Board (TIB)
    - G. Trunk Control Module (TCM)
- XII. **Trunked System Signalling (Type I)**
    - A. Idle System (fixed end)
    - B. Voice Channel Request
    - C. Channel Grant/Busy - High Speed Handshake
    - D. Acknowledge Tone
    - E. Connect Tone/Low Speed Handshake (Connect Word)
    - F. Disconnect Tone
    - G. Call Continuation
    - H. Disconnect Word
    - I. Failsoft

XIII. Board Circuit Descriptions

- A. Site Controller Board
- B. Inbound Recovery Board
- C. Receiver Interface Board
- D. Transmitter Interface Board
- E. Trunk Control Module (Micor)
- F. Trunk Control Module (Analog MSF-5000)
- G. Trunked Tone Remote Control Module (Digital MSF-5000)

Quiz #2

TYPE II TRUNKING OVERVIEW

I. Type II ID's

- A. Universal
- B. Talkgroup
- C. Announcement Group
- D. Radio's Programming
- E. Central Controller Programming
- F. Hybrid System

II. Type II Signalling

- A. Idle System
- B. Voice Channel Request
- C. Channel Grant/Busy
- D. Connect Tone/Low Speed Handshake (Connect Word)
- E. End of Transmission (Disconnect Tone)
- F. Call Continuation
- G. Disconnect Word

Tab II Options

I. Additioal Call Types

- A. Private Conversation
  - 1. Private Conversation One, PC I
  - 2. Private Conversation Two, PC II
  - 3. Private Conversation Unlimited
- B. Call Alert
  - 1. General
  - 2. Call Alert I
  - 3. Call Alert II

C. Emergency Call

1. What is Emergency Call?
2. Emergency Call Alternatives
3. Reserved Emergency Channel
4. Ruthless Pre-emption
5. Top-of-Queue
6. Capabilities

D. Telephone Interconnect

1. Description

2. Telco Lines

3. Dialing Options

4. Privacy

5. Call Routing

6. Mobile Operational Considerations

7. Master Control Board (MCB)

8. Phone Line Interface Board (PLIB)

9. Trunked Repeater Interface Board (TRIB)

10. Matrix Board

11. Call Initiation Protocol

12. Interconnect Call Sequence Mobile To Land

13. Interconnect Call Sequence Land To Mobile

14. Detailed Board Description

    a. Matrix Board
    b. Telephone Repeater Interface Board
    c. Phone Line Interface Board

- II. Optional Peripherals
  - A. Smartnet Interface Management System (SIMS)
    - 1. Description
    - 2. SIMS Functions
    - 3. SIMS Additional Capabilities
      - a. Selective Radio Inhibit
      - b. Dynamic Regrouping
      - c. Storm Plans
  - B. Smartnet Control Management System (SCMS)
  - C. Smartnet Information Processor (SIP)
    - 1. Description
    - 2. Features
  - D. Centracom Control Center Systems
    - 1. Description
  - E. Systemwatch
    - 1. Description
    - 2. Features
  - F. Data Logger
    - 1. Description
    - 2. Call Message Explanation
    - 3. Channel or Status Code Explanation
    - 4. LED Display
    - 5. Diagnostic Messages
  - G. System Manager's Terminal
    - 1. Description
    - 2. Functions
    - 3. Hardware Requirements
    - 4. General Operating Procedures
    - 5. Command Functions and Responses
      - a. Affiliate
      - b. Exit/Bye
      - c. Chan
      - d. Date
      - e. Diag

        - f. Parm
        - g. Pass
        - h. Sac
        - i. Serv
        - j. Stat
        - k. Test
        - l. Time
        - m. Ver
        - n. Emrg
        - o. Mgc
        - p. Dvp
        - q. Data
        - r. Site

    - 6. Telephone Interconnect Commands and Responses

        - a. Auth
        - b. Bill
        - c. Tell

    - 7. Automatic System Alarm Capability

III. Optional Software Features

- A. Priority Monitor

Tab III. Labs/Troubleshooting

- A. Equipment Safety

    - 1. Electrostatic Discharge

- B. Equipment Familiarization and Troubleshooting

    - 1. Central Controller Lab
    - 2. System Manager Terminal Lab
    - 3. Basic Central Controller Troubleshooting

Tab IV. **MANUALS**

ACRONYMS USED IN TRUNKING

CSC	CENTRAL SITE CONTROLLER
TSC	TRANSMITTER CONTROLLER
RSC	RECEIVER SITE CONTROLLER
IRB	INBOUND RECOVERY BOARD
RIB	RECEIVER INTERFACE BOARD
TIB	TRANSMITTER INTERFACE BOARD
TCI	TRUNKED CONSOLE INTERFACE BOARD
ACB	ASYNCHRONOUS COMMUNICATIONS BOARD
DCB	DATA CONCENTRATOR BOARD

INTERCONNECT BOARDS

MCB	MASTER CONTROL BOARD
MTRX	MATRIX BOARD
PLIB	PHONE LINE INTERFACE BOARD
TRIB	TELEPHONE REPEATER INTERFACE BOARD

REMOTE SITE CENTRAL BOARDS

RESC	REMOTE SITE CONTROLLER BOARD
RTIB	REMOTE TRANSMITTER INTERFACE BOARD

SPECTRA-TAC COMPARATOR BOARDS

SQM	SIGNAL QUALITY MODULE
SLD	SECONDARY LINE DRIVER
CMD	COMMAND MODULE

DAM	DISCRIMINATOR AMPLIFIER MODULE

CONSOLE PRIORITY INTERFACE BOARDS (CPI)

TPM	TONE PRIORITY MODULE
LDM	LINE DRIVER MODULE
TKM	TONE KEYING MODULE
PS	POWER SUPPLY

CONSOLE INTERFACE BOARDS

BIM	BASE INTERFACE MODULE
CCB	CHANNEL CONTROL BOARD
CCM	CHANNEL CONTROL MODULE
CCP	CHANNEL CONTROL PANEL
CEB	CENTRALIZED ELECTRONICS BANK
LOBL	lINE-OPERATED BUSY LIGHT
LOMI	LOGGING OPERATOR MULTIPLEX INTERFACE
LORI	LOGGING RECORDER INTERFACE
OMI	OPERATOR MULTIPLEX INTERFACE
STM	SYSTEM TIMER MODULE
TIMI	TRUNKING INPUT/OUTPUT OPERATOR INTERFACE MODULE
TBIM	TRUNKED BASE STATION INTERFACE MODULE
TOMI	TRUNKED OPERATOR INTERFACE MODULE

GLOSSARY OF TRUNKING TERMS

ASYNCHRONOUS COMMUNICATIONS BOARD

LOCATED WITHIN A CARDCAGE OF THE CENTRAL CONTROLLER CABINET, THIS COMMUNICATIONS DEVICE IS USED TO INTERFACE BETWEEN THE CENTRALIZED EQUIPMENT BANK (CEB) AND THE CONTROLLER IN TRUNKED SYSTEMS OR BETWEEN SITE CONTROLLERS.

ACKNOWLEDGE TONES

1800 Hz TONE TRANSMITTED ON VOICE CHANNEL BY MOBILE INITIATING A CALL ON TRUNK SYSTEM. ALSO KNOWN AS HIGH SPEED ACKNOWLEDGE TONE.

ALIAS

PROPER NAMES INSTEAD OF UNIT ID, SUBFLEET OR FLEET CHARACTERS.

AUTOMATIC MULTIPLE SITE SELECT

A WIDE AREA COVERAGE TRUNKING SYSTEM CONFIGURATION WHICH MAKES USE OF CHANNEL REUSE TO EXTEND THE COVERAGE AREA OF THE SINGLE SITE SYSTEM.

ANNOUNCEMENT GROUP CALL

THIS IS A FORM OF FLEET-WIDE CALL, WITH THE ANNOUNCEMENT GROUP CONSISTING OF ANY NUMBER OF TALKGROUPS ON THE SYSTEM; THIS CALL MAY BE MESSAGE OR TRANSMISSION TRUNKED.

ANSWER SUPERVISION

A TELCO SUPERVISION ALLOWED ON GROUND START LINES TO ALLOW INDICATION OF WHEN THE LAND LINE ANSWERS AND HANGS UP.

AUTO-AFFILIATION (UNIT REGISTRATION)

TYPE II OPERATION IN WHICH THE SUBSCRIBER UNIT WILL MAKE ITS CURRENT TALKGROUP AFFILIATION KNOWN TO THE CENTRAL AS SOON AS IT IS SELECTED BY THE USER; WHEN THE UNIT FIRST COMES VIA THE CONTROL CHANNEL, INFORMING THE SYSTEM OF ITS CURRENT TALKGROUP AFFILIATION; WHENEVER THE UNIT CHANGES TALKGROUP ON THIS SYSTEM, THE UNIT WILL AUTOMATICALLY INFORM THE CENTRAL OF THE UPDATE AS SOON AS THE CHANGE HAS BEEN MADE; IF THE UNIT DESIRES CALL ACTIVITY PRIOR TO THIS AUTOMATIC OPERATION COMPLETION, THE UNIT REVERTS TO PTT-AFFILIATION.

AUTO RETRY

CIRCUIT IN EACH MOBILE WHICH WILL SEND UP TO 16 (ISW's) IN A 4 SECOND PERIOD OF TIME IF (OSW) IS NOT RECEIVED FROM CENTRAL CONTROLLER.

BACKGROUND OSW

AN OSW SENT BY CONTROLLER TO MOBILES TO MAINTAIN WORK SYNCHRONIZATION ON AN IDLE CHANNEL.

BASE STATION IDENTIFIER (BSI)

PROGRAMMED INTO THE SYSTEM CENTRAL CONTROLLER, WHICH SENDS OUT A MORSE CODE ID ON THE LOWEST FREQUENCY TRUNK REPEATER. THIS IS SOFTWARE CONTROLLED AND WILL ALWAYS CHOOSE THE LOWEST FREQUENCY TO TRANSMIT BSI.

BASE STATION INTERFACE MODULE

BIM, THIS MODULE INTERFACES THE CENTRALIZED EQUIPMENT BANK (CEB) TO CONVENTIONAL RF REPEATERS.

BUSY/CALL BACK

IF ALL TRUNK REPEATERS ARE IN USE, WHEN PTT IS PRESSED, INITIATING MOBILE RECEIVES BUSY TONE. WHEN SYSTEM BECOMES AVAILABLE, MOBILE RECEIVES "CALL BACK" CONSISTING OF A BURST OF TONES. BUSY TONE IS INDICATIVE THAT YOU REACHED THE CONTROLLER AND THE CONTROLLER IS TELLING THE MOBILE IT IS BUSY.

COMPUTER-AIDED DISPATCH

THE CURRENT CONVENTION IN PUBLIC SAFETY RADIO COMMUNICATIONS DICTATES USE OF COMPUTERS IN ORDER TO ANSWER REQUESTS FOR EMERGENCY SERVICE MORE EFFICIENTLY.

CALL ALERT ONE

CAI, INDIVIDUAL ALERT DIRECTED TO A UNIT ON THE TRUNKING SYSTEM (IDENTITY USED IN THE ALERT) VIA THE CONTROL CHANNEL SIGNALLING ONLY, NO VOICE PHASE FOR THIS OPERATION.

CALL ALERT TWO

CAII, INDIVIDUAL ALERT DIRECTED TO A UNIT VIA THE CONTROL CHANNEL, BUT THE IDENTITY OF THE ALERTING UNIT IS ALSO PRESENT IN THE ALERT TO ALLOW THE ALERTED UNIT TO MAKE A SUBSEQUENT VOICE CALL TO THE ALERTING UNIT IF DESIRED.

CENTRACOM II INTERFACE CONTROL MODULE

THIS MODULE RESIDES IN THE CEB AND SERVES MUCH THE SAME FUNCTION AS AN OMI MODULE. THIS MODULE COMMUNICATES WITH THE TRUNKING CONTROLLER VIA A BI-DIRECTIONAL RS-232 LINK.

CENTRAL SITE CONTROLLER BOARD (CSC)

THE CSC MODULE ACCEPTS INPUTS FROM THE RSC, DECIDES UPON THE APPROPRIATE COURSE OF ACTION AND TELLS THE TSC WHAT TO DO. THE MAJOR FUNCTION OF THE CSC INCLUDE CALL PROCESSING, CALL QUEUING, RESOURCE ALLOCATION, DIAGNOSTICS, SITE TO SITE PROTOCOL, LOGGING OF USAGE STATISTICS, AND INTERFACING WITH KEYBOARD TERMINAL.

CENTRALIZED ELECTRONICS BANK

CEB, THIS UNIT IS THE MAIN PROCESSING BANK OF THE CENTRACOM-II, WHICH PROVIDES INTERFACING BETWEEN THE CONSOLE CONTROLLER AND RF EQUIPMENT.

CENTRALIZED INTERCONNECT TERMINAL

CIT, IS LOCATED IN A CARDCAGE IN THE CENTRAL CONTROLLER WHERE TELEPHONE INTERCONNECT IS A REQUIRED FEATURE. THIS TERM MAY ALSO BE REFERRED TO AS "PASSPORT" OR SIMPLY "INTERCONNECT".

CHANNEL CONTROL BOARD

THE CCB IS PART OF THE CENTRACOM-II CONSOLE

CHANNEL CONTROL MODULE

THE CCM IS PART OF THE CENTRACOM-II CONSOLE

CHANNEL CONTROL PANEL

THE CCP IS PART OF THE CENTRACOM-II CONSOLE

CODEPLUG

FUSIBLE-LINK PROM WHICH CONTAINS ANNOUNCEMENT GROUP, TALKGROUP, INDIVIDUAL ID, CHANNEL INFORMATION, FAIL SOFT CHANNEL (OPT), TALK PERMIT TONE (OPT), TIME OUT TIMER, AND CONNECT TONE FREQUENCY.

CONNECT TONE

SUBAUDIBLE TONE (BELOW 300 HZ) THAT IS TRANSMITTED BY A MOBILE OR PORTABLE TO THE SYSTEM, ANYTIME THE UNIT IS KEYED. THE SPECIFIC FREQUENCY OF THIS TONE IS DETERMINED BY THE PROGRAM OF THE MOBILE OR PORTABLE AND MUST MATCH THE FREQUENCY THAT IS PROGRAMMED IN THE CENTRAL CONTROLLER.

CONNECT TONE DECODER (CTD)

THIS IS AN EXTERNAL "GATE" FOR THE AUDIO ON A SYSTEM TO REDUCE CO-CHANNEL INTERFERENCE. IT WILL NOT PASS ANY RECEIVED AUDIO FOR THIS CHANNEL, UNLESS THE AUDIO IS ALSO ACCOMPANIED BY THE PROPER LOW SPEED CONNECT TONE FOR THIS SYSTEM.

CONNECT WORD/LOW SPEED HANDSHAKE

THE CONNECT WORD IS A SUBAUDIBLE DATA WORD WHICH IS TRANSMITTED BY THE TRUNKED SYSTEM TO THE MOBILE AND PORTABLE UNITS. THIS 150 BAUD DATA WORD IS TRANSMITTED BY THE TRUNKED SYSTEM AT A LEVEL OF + 500 Hz TO ALLOW FOR UNINTERRUPTED COMMUNICATIONS TO THE MOBILE OR PORTABLE. CONNECT WORD TRANSMISSION PROBLEMS ARE CHARACTERIZED BY "AUDIO HOLES", OR MISSING SYLLABLES, IN THE MOBILE/PORTABLE'S RECOVERED AUDIO.

CONSOLE WIRELINE INTERFACE (CWI)

THIS IS THE RACK OF EQUIPMENT WITHIN (USUALLY) THE CENTROL CONTROLLER. IT CONSISTS OF AN ACB AND A TCI. THE SYSTEM WILL ALSO HAVE, AS PART OF THE CWI, BUT LOCATED SEPERATELY, A CONSOLE PRIORITY INTERFACE (CPI) RACK.

CONSOLE PRIORITY INTERFACE

AS PART OF THE CONSOLE WIRELINE INTERFACE (CWI), THE CPI ALLOWS FOR PRIORITY SYSTEM TRANSMIT AUDIO FROM THE CONSOLE. THIS MEANS THAT REGARDLESS OF MOBILE OR PORTABLE RADIO TRAFFIC, THE CONSOLE OPERATOR'S AUDIO WILL OVERRIDE ANY EXISTING RADIO TRAFFIC DURING PERIODS OF TRANSMISSION. THE CPI USUALLY CONSISTS OF A TONE PRIORITY MODULE (TPM), A TONE KEYING MODULE (TKM), A COMMAND MODULE, AND A POWER SUPPLY.

CONSOLE PRIORITY SHELF

LOCATED IN THE TRUNKED BASE STATION REPEATER, IT PROVIDES AN INTERFACE TO THE TRUNKED CENTRACOM SERIES II CONSOLE AND GIVES PRIORITY TO CONSOLE AUDIO OVER REPEAT AUDIO.

CONTINUOUS ASSIGNMENT UPDATING

FUNCTION OF THE CENTRAL CONTROLLER - CONTINUALLY SENDS (OSW) ON CONTROL CHANNEL FOR THE DURATION OF A CONVERSATION. THIS ENSURES THAT A MOBILE JUST COMING INTO SERVICE WILL BE SENT TO THE CORRECT VOICE CHANNELS.

CONTROL CHANNEL

A REPEATER DEDICATED FOR THE PURPOSE OF CONTINUOUS DATA TRANSMISSION USED FOR MOBILE ASSIGNMENTS AND UPDATES. CONTROL CHANNEL ASSIGNMENT IS UNDER CENTRAL CONTROLLER SUPERVISION.

CONTROL CHANNEL INDICATOR

THE SIGNAL THAT TELLS THE REPEATER'S DISCRIMINATOR TO BE IN THE VOICE OR DATA MODE IS CALLED THE CCI

CONTROL CHANNEL INTERFACE

THE RF INTERFACE BETWEEN SIMS AND ANY SMARTNET CENTRAL CONTROLLER IS COMMONLY REFERRED TO AS CCI.

DATA CONCENTRATOR BOARD (DCB)

THIS BOARD IS PART OF A TRUNKED SIMULCAST OR AMSS SYSTEM CENTRAL CONTROLLER. IT IS USUALLY ASSOCIATED WITH AN ASYNCRONOUS COMMUNICATIONS BOARD (ACB) TO COMMUNICATE WITH REMOTE CENTRAL CONTROLLERS.

DIGITAL LEVEL MEMORY (DLM)

AUOTMATICALLY ADJUSTS THE GAIN OF AMPLIFIERS OVER A WIDE RANGE OF INPUTS TO ASSURE A CONSTANT OUTPUT. THE GAIN DOES NOT INCREASE DURING A PAUSE IN SPEECH, BUT RATHER IS HELD IN MEMORY UNTIL A NEW SIGNAL LEVEL REQUIRES AN ADJUSTMENT.

DISCONNECT TONE

163.64 Hz GENERATED BY TRANSMITTING MOBILE ON VOICE CHANNEL AFTER PTT IS RELEASED - TELLS CENTRAL CONTROLLER TO START REPEATER DROP-OUT IN MESSAGE TRUNKING.

DISCONNECT WORD

DATA TRANSMITTED FROM CENTRAL CONTROLLER ON VOICE CHANNEL REPEATER AFTER DROP-OUT DELAY IN MESSAGE TRUNKING, CAUSING MOBILE'S RECEIVER AUDIO TO MUTE AND THE MOBILE TO REVERT BACK TO CONTROL CHANNEL. ALSO KNOWN AS LOW SPEED DISCONNECT DATA.

DYNAMIC REGROUPING

THIS SIMS OPTION ALLOWS UNITS IN SERVICE TO BE "REGROUPED" INTO OTHER TALKGROUPS AND RECEIVE REPROGRAMMING OF CERTAIN PARAMETERS VIA SIGNALLING OVER THE CONTROL CHANNEL.

EPII

ENHANCED PROTOCAL II

ETHERNET

A LOCAL AREA NETWORK (L.A.N.) OF IBM PC'S USED IN SOME SMARTNET SYSTEM CONFIGURATIONS HAVING THE SIMS OPTION

FAILSOFT

ACTIVATED IF SYSTEM CENTRAL CONTROLLER IS INOPERATIVE. REPEATERS REVERT TO CONTINUOUSLY KEYED CARRIER SQUELCH REPEATERS. TRUNKED MOBILES REVERT TO THEIR CODE PLUG PROGRAMMED REPEATER. MOBILES WILL HEAR A TONE EVERY 10 SECONDS INDICATING FAILSOFT OPERATION, (900 Hz TONE 280 MS EVERY 10 SECONDS).

FIFO

FIRST-IN, FIRST-OUT. QUEUE. IN THE CASE OF A BUSY TRUNKED SYSTEM, INDIVIDUAL REQUESTS FOR SERVICE WILL BE HANDLED IN A FIFO MANNER.

FLEET

A BASIC ORGANIZATION OR COMPANY SERVED BY A MOTOROLA TRUNKED SYSTEM. ONE ORGANIZATION OR COMPANY PER FLEET.

GROUND START

THIS IS A TYPE OF PHONE LINE SUPERVISION IN WHICH THE REVERSAL OF THE CURRENT IN THE LINE IS AN INDICATION OF A CHANGE OF STATE OF THE LINE.

GROUP REGROUP

THIS IS THE MECHANISM TO TEMPORARILY JOIN DISSIMILAR TRUNKING TALKGROUPS FOR CALLS UPON A SINGLE CHANNEL RESOURCE.

HIGH SPEED HANDSHAKE (HSH)

THIS IS HIGH SPEED DATA SENT ON THE NEWLY ASSIGNED VOICE CHANNEL TO BE USED AS VERIFICATION TO SUBSCRIBER UNITS OF WHO IS TO BE USING THIS CHANNEL CURRENTLY (TYPE I NON-EPII ONLY).

HIGH SPEED ACKNOWLEDGE TONE (HS ACK)

THIS IS THE HIGH FREQUENCY TONE SENT BY THE SUBSCRIBER UNIT TO INDICATE THAT IT HAS BEEN ASSIGNED TO THE CHANNEL AND IS READY TO BEGIN TRANSMISSION (TYPE I NON-EPII ONLY).

INBOUND RECOVERY BOARD (IRB)

THIS BOARD WORKS IN CONJUNCTION WITH THE BASE STATIONS THAT ARE USED AS CONTROL CHANNEL TRANSMITTERS/RECEIVERS TO PROCESS INBOUND SIGNALLING WORDS (ISW'S). CONTAINS THREE SIGNAL PROCESSING SUB-SYSTEMS.

INBOUND SIGNALLING WORD (ISW)

A BURST OF DATA FROM A MOBILE/PORTABLE OR BASE STATION WITHIN THE SYSTEM. OCCURS DURING THE FIRST FEW MILLISECONDS OF A UNIT'S TRANSMISSION , THE ISW IDENTIFIES THAT UNIT TO THE CENTRAL CONTROLLER BY CONTAINING INFORMATION ABOUT ANNOUNCEMENT GROUP, TALKGROUP, AND INDIVIDUAL UNIT ID AND TYPE OF CALL.

INTERCONNECT

INTERCONNECT IS SOMETIMES REFERRED TO AS CIT OR PASSPORT, AND IS AN OPTIONAL TELEPHONE INTERCONNECT TO A TRUNKED SYSTEM. MOBILE/PORTABLE UNITS THAT HAVE THIS OPTION HAVE INDEPENDENT AND AUTOMATIC TELEPHONE CALL CAPABILITY.

INTERCONNECT UNIT (ICU)

GLOBAL TERM TO DISCRIBE THE SECTION OF THE FIXED END INVOLVED WITH INTERFACING TO THE PHONE SYSTEM (MCB, MATRIX, PLIB, TRIB).

LINE-OPERATED BUSY LIGHT (LOBL)

INDICATOR LIGHT USED ON THE TRUNKED CENTRACOM-II CONSOLE TO INDICATE THAT A REPEATER IS DISABLED.

LOGGING OPERATOR MULTIPLEX INTERFACE (LOMI)

PART OF THE CENTRACOM-II, THIS ITEM IS MORE COMMONLY CALLED A LOGGING OPERATOR INTERFACE MODULE.

LOGGING RECORDER INTERFACE (LORI)

PART OF THE CENTRACOM-II CONSOLE USED TO INTERFACE TO A RECORDING DEVICE.

LOOP START

THIS IS A TYPE OF PHONE LINE SUPERVISION IN WHICH THE FLOW OF CURRENT IN THE LINE IS THE INDICATION OF THE ACTIVATION.

LOW-SPEED HAND SHAKE (LSHS)

REFER TO "CONNECT WORD" FOR MORE DETAILS.

MASTER CONTROL BOARD (MCB)

HAS THE SAME HARDWARE AND SLIGHTLY MODIFIED FIRMWARE AS THE CENTRAL SITE CONTROLLER (CSC), THE MCB IS THE MAIN PROCESSOR IN CHARGE OF THE CENTRALIZED INTERCONNECT TERMINAL (CIT).

MATRIX

THE MATRIX BOARD IS LOCATED INSIDE THE CENTRALIZED INTERCONNECT TERMINAL (CIT) AND ACTS AS THE INTERFACE BETWEEN THE PHONE LINE INTERFACE BOARD (PLIB) AND THE TELEPHONE REPEATER INTERFACE BOARD (TRIB).

MESSAGE TRUNKED

THE MOBILE UNITS RETAIN THE SAME VOICE CHANNEL FOR THE DURATION OF THEIR MESSAGE, INITIAL TRANSMIT MOBILE HEARS REPEATER DROP-OUT AFTER RELEASE OF PTT (ANNOUNCEMENT GROUP/TALKGROUP CALLS).

MSEL

THIS IS A FORM OF GROUP REGROUPING IINTENDED FOR ALERT TYPE MESSAGES FROM THE DISPATCHER TO A LARGE COLLECTION OF TALKGROUPS AS A SINGLE TALKGROUP, ONCE AGAIN UPON A SINGLE CHANNEL RESOURCE; THIS CALL IS TO BE OF TRANSMISSION TRUNKING TYPE WITH THE CHANNEL RELEASED WHEN THE DISPATCHER FINISHES THE TRANSMISSION.

NEGATIVE SUBSCRIBER LIST

PROVIDES SYSTEM OWNER WITH THE ABILITY TO DELETE UP TO 16 FLEETS FROM ACTIVE SERVICE ON THE TRUNK SYSTEM. OPTION IN THE CENTRAL CONTROLLER MUST BE USED WITH A TERMINAL.

OPERATOR INTERFACE MODULE

CONTAINS THE PERSONALITY OF A DISPATCH POSITION IN A MICROPROCESSOR'S PROM, UNIQUELY PROGRAMMED WITH THE FUNCTIONAL IDENTITY OF EVERY ACTIVE SWITCH IN THE CONSOLE

OPERATOR MULTIPLEX INTERFACE (OMI)

THE OMI IS PART OF THE CENTRACOM-II CONSOLE.

OUTBOUND SIGNALLING WORD (OSW)

DATA SENT BY CENTRAL CONTROLLER OVER THE CONTROL CHANNEL OF A TRUNKED SYSTEM AT A RATE OF 3600 BAUD TO THE MOBILES/PORTABLES AND BASE STATIONS WITHIN THE SYSTEM. USED FOR CHANNEL ASSIGNMENTS AND OTHER CONTROL FUNCTIONS. CHANNEL ASSIGNMENTS ARE RANDOMLY REPEATED DURING RADIO CONVERSATION TO UPDATE NEW MOBILES, PORTABLES COMING ONTO THE SYSTEM.

OUT OF RANGE

THIS IS A TONE SEQUENCE HEARD AT THE SUBSCRIBER UNIT TO INDICATE THAT THE UNIT IS NO LONGER WITHIN RANGE OF THE TRUNKING SYSTEM (THIS MEANS THE UNIT CANNOT ACHIEVE RECEPTION OF A VALID CONTROL CHANNEL FOR THIS SELECTED SYSTEM).

PARM'S OPTION

OPTION IN THE CENTRAL CONTROLLER TO ALLOW A REPEATER DROP-OUT DELAY AND OTHER FADE MARGINS TO BE CHANGED - USED WITH A SYSTEM'S MANAGER TERMINAL.

PASSPORT

THIS TERM IS USED INTERCHANGEABLY WITH INTERCONNECT OR CENTRALIZED INTERCONNECT TERMINAL (CIT).

PATCH

THIS IS A FORM OF GROUP REGROUPING IN WHICH THE JOINED GROUPS ARE ALLOWED TO CARRY ON NORMAL MESSAGE TRUNKING OPERATIONS BETWEN AND AMONG ALL THE SEPERATE MEMBER GROUPS OF THE CALL, UPON A SINGLE CHANNEL RESOURCE.

PERSONALITY PROM

A PROM WHICH STORES THE RADIO'S INDIVIDUAL ID AND OTHER SPECIAL FUNCTION FIRMWARE THAT GIVES IT IT'S OWN UNIQUE IDENTITY.

PHONE LINE INTERFACE BOARD (PLIB)

A CIRCUIT BOARD WITHIN THE CENTRALIZED INTERCONNECT TERMINAL (CIT) THAT INTERFACES WITH THE TELEPHONE COMPANY'S PULSECOM.

PRIME SITE

THE PRIMARY EQUIPMENT SITE OF A TRUNKED SIMULCAST OR AMSS SYSTEM WHERE ALL AUDIO PROCESSING OCCURS AND RF CHANNEL RESOURCE MANAGEMENT IS ACCOMPLISHED.

PRIVATE CALL I (PC I)

INDIVIDUAL CALL IN WHICH THE CALLED PARTY IDENTITY IS THE ONLY TRUNKING IDENTITY USED FOR THE CALL.

PRIVATE CALL II (PC II)

INDIVIDUAL CALL IN WHICH BOTH THE CALLED PARTY AND THE CALLING PARTY IDENTITY ARE USED IN THE CALL.

PTT

THIS ACRONYM IS SHORT FOR "PUSH-TO-TALK".

PTT-ID

PUSH TO TALK IDENTIFICATION. THIS IS AN OPTIONAL FEATURE WHICH ALLOWS A SIMS OR TIP USER TO VIEW THE IDENTITY OF CALLERS WHEN THEY PRESS THEIR PTT.

PULSE-COM

A CERTIFIED PRODUCT TO INTERFACE OUR INTERCONNECT EQUIPMENT TO THE PHONE LINES.

QUEUING

MEMORY IN THE SYSTEM CENTRAL CONTROLLER WHICH IS USED OF THE SYSTEM IS BUSY, STORES MOBILE INFORMATION, AND MAKES SYSTEM AVAILABLE TO USERS ON A FIRST-IN FIRST-OUT BASIS.

RADIO INTERFACE BOX

THIS IS USED TO PERFORM LEVEL SHIFTING FOR THE IN-RADIO PROGRAMMING OF THE PERSONALITY EPROMS VIA SOME FIELD PROGRAMMING UNIT.

RADIO INTERFACE MODULE (RIM)

THIS MODULE ACTS AS THE INTERFACE BETWEEN A SPECIAL CONTROL CHANNEL INTERFACE (CCI) CONSOLETTE BASE STATION AND A SMARTNET TERMINAL.

RANDOM RETRY

THE SUBSCRIBER UNIT WILL REQUEST SERVICE ON THE INBOUND CONTROL CHANNEL AND AWAIT THE RESPONSE ON THE OUTBOUND CONTROL CHANNEL; IF NO RESPONSE IS RECEIVED IN A PRESCRIBED PERIOD OF TIME, THE UNIT WILL AUTOMATICALLY RE-REQUEST ON THE CONTROL CHANNEL AND WAIT UNTIL THE RESPONSE IS RECEIVED, OR UNTIL A PRESCRIBED RETRY TIME PERIOD HAS BEEN EXCEEDED. 16 TRIES IN A FOUR SECOND TIME PERIOD.

RECENT USER PRIORITY

INSURES THAT A SUBFLEET ENGAGED IN A CONVERSATION WILL GET PRIORITY SYSTEM ACCESS OVER ANOTHER SUBFLEET INITIATING A CALL.

RECEIVER INTERFACE BOARD (RIB)

THIS BOARD IS USED TO DETECT THE TONE SIGNALLING FROM THE MOBILES/PORTABLES IN THE SYSTEM AND PASS THIS INFORMATION ON TO THE RSC AND CSC FOR INTERPRETATION AND ACTION.

RECEIVER SITE CONTROLLER (RSC)

THIS BOARD PROCESSES INFORMATION FROM AND SUPERVISES THE OPERATION OF THE RECEIVER SECTIONS OF THE REPEATERS,ie THE IRB AND RIB.

REMOTE INTERFACE NODE (RIN)

THIS IS THE GATEWAY NODE OF THE SIMS NETWORK TO ALLOW REMOTING OF USER NODES FROM THE MAIN SIMS NETWORK.

REMOTE SITE

IN A TRUNKED SIMULCAST OR AMSS SYSTEM THE SITES THAT ARE CONTROLLED BY THE PRIME SITE TO PROVIDE WIDE AREA COVERAGE. A REMOTE SITE MUST BE CO-LOCATED WITH THE PRIME SITE.

REMOTE SITE CONTROLLER (ReSC OR RCSC)

LOCATED AT A REMOTE REPEATER SITE, THE ReSC OR RCSC RECEIVES DATA LINK INSTRUCTIONS THAT ENSLAVE THE REMOTE SITE FROM THE CENTRAL SITE CONTROLLER (CSC) OF THE PRIME SITE. THIS IS ACCCOMPLISHED THROUGH THE DATA CONCENTRATOR BOARD (DCB) AND THE ASSOCIATED ASYNCRONOUS COMMUNICATIONS BOARD (ACB).

REMOTE TRANSMITTER INTERFACE BOARD (RTIB)

THE CIRCUIT BOARD THAT PROVIDES THE INTERFACE BETWEEN THE REMOTE SITE CONTROLER (ReSC) AND THE REPEATER IN A SIMULCAST TRUNKING SYSTEM.

R-STAT

RECEIVE STATUS

SECONDARY LINE DRIVER MODULE (SLD)

A MODULE THAT IS COMMONLY USED WITHIN THE SPECTRA-TAC COMPARATOR OF A WIDE AREA TRUNKED SYSTEM FOR TELEPHONE INTERCONNECT (PASSPORT) CHANNELS.

SELECT ENABLE/DISABLE

THIS IS A FEATURE TO RESTRICT THE MOVEMENT OF A SUBSCRIBER UNIT FROM THE ASSIGNED DYNAMIC IDENTITY; IF THE UNIT HAS BEN SELECT DISABLED, THE USER OF THE SUBSCRIBER UNIT WILL NOT BE ABLE TO CHANGE TO ANOTHER IDENTITY POSITION UNTIL THE REPROGRAMMING OR SELECT DISABLE HAS BEEN CANCELLED.

SELECTIVE (RADIO) INHIBIT

AN IMPORTANT SMARTNET FEATURE TO PUBLIC SAFETY USERS WHICH ALLOWS A SIMS OPERATOR TO INSTANTLY AND EFFECTIVELY "PUT TO SLEEP" A MOBILE OR PORTABLE UNIT IN THE FIELD. THE TARGET RADIO MUST BE TURNED ON AND WITHIN SYSTEM RANGE IN ORDER FOR THIS FEATURE TO WORK.

SIMULCAST

A WIDE AREA COVERAGE SYSTEM CONFIGURATION WHICH MAKES USE OF SIMULTANEOUS TRANSMISSION OF THE SAME INFORMATION UPON THE SAME FREQUENCIES THROUGHOUT A LARGE COVERAGE AREA; PARAMETERS OF THE TRANSMITTED INFORMATION ARE MATCHED FOR EACH REPEATER OF A GIVEN FREQUENCY.

SMARTNET INFORMATION MANAGEMENT SYSTEM (SIMS)

AN OPTIONAL "LOCAL AREA NETWORK" (LAN) OF PC'S THAT CAN OBSERVE PUSH-TO-TALK ID'S, DYNAMICALLY REGROUP RADIOS, SELECTIVELY INHIBIT RADIOS, AND PERFORM OTHER FUNCTIONS DEPENDING ON OPTIONS ON THE SMARTNET SYSTEM.

SMARTNET INTEGRATED SYSTEMS (SIS)

A SET OF FEATURES WHICH PROVIDES SYSTEM-TO-SYSTEM INTEROPERABILITY FOR TRUNKING AND CONVENTIONAL USERS.

STANDBY CENTRAL CONTROLLER

THE WORD "STANDBY" SHOULD TELL YOU THAT THIS IS A REDUNDANT CENTRAL CONTROLLER. THIS IS THE TYPE OF SYSTEM BACKUP THAT IS FAVORED BY PUBLIC SAFETY USERS, SINCE THE STANDBY CENTRAL CONTROLLER CAN AUTOMATICALLY TAKE CONTROL OVER THE TRUNKED SYSTEM IN THE EVENT OF A MAIN CENTRAL CONTROLLER FAILURE.

STATUS TONE

GENERATED BY THE SPECTRA-TAC ENCODER INSTALLED IN A RECEIVER TO BE USED AS A REFERENCE DURING PERIODS OF RECEIVER INACTIVITY AND IS USED AS AN INDICATION THAT A RECEIVER IS NOT RECEIVING IN AN AMSS OR SIMULCAST SYSTEM. FREQUENCY USED IS 2175 HZ.

STORM PLAN

A FUNCTION PERFORMED BY A SIMS SYSTEM THAT ALLOWS THE INITIATION OF PREPROGRAMMED CONTINGENCY PLANS ON A TRUNKED COMMUNICATIONS SYSTEM FOR SPECIAL PURPOSES SUCH AS NATURAL DISASTERS, PARADES, VIP VISITS ETC. UTILIZES SIMS FEATURES SUCH AS DYNAMIC REGROUPING, DYNAMIC FAILSOFT, AND SELECTOR DISABLE.

SUBFLEET

A SUBGROUPING OF RADIO USERS WITH SOME COMMONALITY IN A TYPE I SYSTEM. SUBFLEET ACTIVITY IS NOT HEARD BY OTHER SUBFLEETS.

SUBSCRIBER ACCESS CONTROL (SAC)

SOFTWARE OPTION OF THE FIXED END TO ALLOW THE RESTRICTION OF POSSIBLE TRUNKING OPERATIONS OF UNITS OR GROUPS UPON THE TRUNKING SYSTEM.

SUPER REGROUP

THIS IS THE MECHANISM TO TEMPORARILY JOIN DISSIMILAR TRUNKING TALKGROUPS FOR CALLS UPON A SINGLE CHANNEL RESOURCE.

SUPERGROUP

THIS IS THE TALKGROUP WHICH ALL THE MEMBER GROUPS OF A GROUP REGROUPING ARE JOINED IN AND USE AS THEIR NEW COMMON TRUNKING TALKGROUP.

SYSTEM ID OSW

SENT BY CONTROLLER TO IDENTIFY ITSELF TO ALL LISTENING MOBILES. SENT OUT EVERY THREE SECONDS ON THE CONTROL CHANNEL, REGARDLESS OF SYSTEM TRAFFIC. CONTAINS CONTROL CHANNEL FREQUENCY NUMBER.

SYSTEM MANAGER INTERFACE

ONE OF SEVERAL COMPUTERS WHICH MAKES UP SIMS. THE SYSTEM MANAGER INTERFACE COMPUTER IS USED AS A "COMMUNICATION PROCESSOR" TO MANAGE THE FLOW OF INFORMATION BETWEEN THE CENTRAL CONTROLLER AND SIMS.

SYSTEM MANAGER PORT

THE RS-232 COMMUNICATIONS PORT ON THE CENTRAL CONTROLLER. IN A SYSTEM WITH SIMS, THIS PORT IS CONNECTED OT THE SYSTEM MANAGER INTERFACE COMPUTER.

SYSTEM MANAGER'S TERMINAL (SMT)

A HARD-COPY TERMINAL CONNECTED EITHER DIRECTLY TO ITS DEDICATED RS-232 PORT AT THE REAR OF THE CONTROLLER, OR REMOTELY VIA DATA MODEMS, OR THROUGH A SIMS INTERFACE, OR THROUGH ANOTHER INTERACTIVE SITE CONTROLLER BOARD. THE SMT CAN BE USED TO DIAGNOSE SYSTEM PROBLEMS AND/OR TO CHANGE SYSTEM PARAMETERS SUCH AS "MESSAGE TRUNKING HANGTIME".

SYSTEM SEARCH AND LOCK (SS&L)

AN OPTIONAL FEATURE WHICH PROVIDES ROAMING CAPABILITY TO RADIO USERS.

SYSTEM TIMER MODULE (STM)

PART OF THE CENTRACOM-II CONSOLE

SYSTEM WATCH

A DIAGNOSTIC TOOL USED TO MONITOR SYSTEM ACTIVITY, PROVIDING REAL TIME DISPLAY OF ALL CALL ACTIVITY AS IT OCCURS.

T-BAR SWITCH

THIS SWITCHING DEVICE IS USED BY SMARTNET SYSTEMS WHICH HAVE REDUNDANT CENTRAL CONTROLLERS. THE T-BAR CAN SWITCH CONTROL AND RS-232 LINES FROM THE REPEATERS.

T-STAT

TRANSMIT STATUS. A DC SIGNAL THAT IS CONTROLLED BY TRANSMITTER FORWARD POWER, TRANSMITTER REFLECTED POWER, AND OTHER POSSIBLE INPUTS, WHICH IS USED AS AN INPUT INTO THE CENTRAL CONTROLLER TO DETERMINE THE USABILITY OF A PARTICULAR REPEATER. T-STAT IS HIGH WHEN THE TRANSMITTER IS GOOD.

TALKGROUP

THE PRIMARY LEVEL OF ORGANIZATION OF USERS ON A TRUNKED RADIO SYSTEM. TALKGROUP ACTIVITY IS NOT HEARD BY OTHER TALKGROUPS.

TALK PERMIT TONE (OPT)

PROVIDES THE MOBILE OPERATOR WITH A BRIEF SERIES OF TONES WHENEVER HE KEYS UP A VOICE CHANNEL. THE TONES ARE THE SAME AS "CALL BACK" TONES.

TALK PROHIBIT TONE

AUDIBLE TONE HEARD OUT OF THE MOBILE SPEAKER WHEN PTT IS DEPRESSED AND ACCESS TO THE TRUNK SYSTEM IS: 1) NOT RECEIVED - MOBILE IS OUT OF RANGE OF THE SYSTEM AND A CONTINUOUS TONE WOULD BE HEARD. 2) SYSTEM BUSY - AN INTERRUPTED TONE IS HEARD, MENTIONED UNDER BUSY/CALL BACK.

TCMS

TRUNKING CODE MANAGEMENT SYSTEM.

TELEPHONE REPEATER INTERFACE BOARD (TRIB)

THIS BOARD IS PART OF THE CENTRALIZED INTERCONNECT TERMINAL (CIT) AND ACTS AS THE INTERFACE BETWEEN THE REPEATER AND THE CIT.

TIME-OUT PARAMETER

REFERS TO THE LENGTH OF TIME A TRANSMITTER IS ALLOWED TO STAY KEYED UP BEFORE BEING AUTOMATICALLY UNKEYED.

TIME-OUT TIMER, MOBILE

INFORMATION PROGRAMMED INTO CODE PLUG PROVIDING 0, 15, 30, OR 60 SECOND TIME-OUT.

TONE PRIORITY MODULE (TPM)

IN A SMARTNET SYSTEM, THIS MODULE IS PART OF THE CONSOLE PRIORITY INTERFACE (CPI). THE TPM MUTES TRANSMITTER REPEAT AUDIO AND REPLACES IT WITH CONSOLE TRANSMIT AUDIO.

TOP OF QUEUE

THIS IS A METHOD OF ACQUIRING A CHANNEL FOR AN EMERGENCY CALL WHEN NO CHANNELS ARE CURRENTLY AVAILABLE; IT ENTAILS SETTING ALL THE CURRENT LOWER PRIORITY CALLS TO TRANSMISSION TRUNKING AND SETTING THIS EMERGENCY CALL UPON THE CHANNEL OF THE FIRST CALL TO TERMINATE; THIS APPROACH MUST AWAIT A FREE CHANNEL, BUT DOES NOT EXPERIENCE THE POSSIBLE INTERFERENCE AS THE RUTHLESS PRE-EMPTION METHOD DOES.

TRANSMISSION TRUNKED

THE MOBILE UNIT DOES NOT RETAIN THE SAME VOICE CHANNEL AFTER RELEASE OF PTT AND WILL NOT HEAR REPEATER DROP OUT AFTER RELEASE OF PTT (i.e. FLEET CALL). TRANSMISSION TRUNKED CALLS REQUIRE A NEW ISW REQUEST BEFORE SECOND TRANSMISSION CAN BEGIN.

TRANSMITTER INTERFACE BOARD (TIB)

RECEIVES THE MPU ADDRESS AND DATA BUS SIGNAL FROM THE TRANSMITTER SITE CONTROLLER (TSC) AND CHANGES THEM INTO DATA AND CONTROL SIGNALS THAT CAN BE USED BY THE BASE REPEATER TRANSMITTER. THIS BOARD CONTROLS SEVEN BASE STATION REPEATERS. FIVE SIGNALS GO TO EACH OF THE SEVEN DIFFERENT REPEATERS (CHANNELS).

1. DATA +
2. DATA -
3. PTT (PUSH-TO-TALK)
4. MUTE
5. TICKLE

TRANSMITTER SITE CONTROLLER BOARD (TSC)

THE MAJOR FUNCTIONS PROGRAMMED INTO THE TSC SOFTWARE PACKAGE INCLUDE: THE GENERATION OF OUTBOUND DATA FROM THE SYSTEM CONTROL CHANNEL AND THE GENERATION OF SUB-AUDIBLE DATA, WHICH IS SUPERIMPOSED ON ALL VOICE CHANNELS.

TRUNKED BASE STATION INTERFACE MODULE (TBIM)

PART OF THE CENTRACOM-II CONSOLE.

TRUNKED CONSOLE INTERFACE BOARD (TCI)

THE TCI IS ONE OF TWO CIRCUIT BOARDS WITHIN THE CONSOLE WIRELINE INTERFACE (CWI) CARDCAGE WHICH ALLOWS THE CENTRAL SITE CONTROLLER (CSC) TO TALK TO THE CENTRAL ELECTRONICS BANK (CEB).

TRUNKED CONTROL MODULE (TCM)

A MODULE FOUND ONLY WITHIN TRUNKED REPEATERS. THE TCM, IN A SINGLE-SITE OR AMSS SYSTEM, GENERATES A FAILSOFT DATA WORD TO MOBILES, PORTABLES AND BASE STATIONS ON THE SYSTEM DURING FAILSOFT. IT ALSO TRANSMITS A 900 HZ AUDIO TONE APPROXIMATELY EVERY TEN SECONDS WHILE IN THE FAILSOFT MODE, SO THAT THE UNITS WILL KNOW THAT FAILSOFT HAS OCCURRED. IN A SIMULCAST SYSTEM THE FAILSOFT DATA WORD AND TONE COME FROM THE "REAL TCM" WHICH IS THE AUDIO PROCESSING CONTROL MODULE IN THE AUDIO PROCESSOR RACK.

TRUNKED ID PROCESSOR TERMINAL (TIP)

THIS UNIT CAN SHOW PTT ID'S BY MONITORING THE OUTBOUND SIGNALING WORD (OSW'S). THE TIP ALSO OBSERVES EMERGENCIES AND SENDS CALL ALERTS.

TRUNKED INPUT/OUTPUT MULTIPLEXED INTERFACE (TIMI)

AS PART OF THE CENTRACOM-II, THIS CIRCUIT BOARD ACTS AS THE INTERFACE BETWEEN THE CENTRALIZED ELECTRONICS BANK (CEB) AND THE CENTRAL CONTROLLER.

TRUNKED OPERATOR INTERFACE MODULE (TOMI)

ONE TOMI MODULE IS ASSIGNED TO EACH OPERATOR'S POSITION IN THE CENTRACOM-II CONSOLE AND IS CONSIDERED TO BE THE "BRAINS" OF ITS ASSIGNED POSITION.

UNIVERSAL ID

THIS IS A PARTICULAR PERSONALITY IN A RADIO UNIT WHICH IS CHOSEN AS THE ONE WHOSE TRUNKING IDENTITY WILL ALWAYS BE USED TO ADDRESS THIS UNIT; IN THIS MANNER, A UNIT WOULD RESPOND TO INDIVIDUAL CALLS INDEPENDENT OF THE CURRENT PERSONALITY CURRENTLY CHOSEN BY THE UNIT.

UPS

UNINTERRUPTIBLE POWER SUPPLY

VOICE CHANNEL

IN A TRUNKED SYSTEM, A VOICE CHANNEL IS AN RF CHANNEL THAT IS AN AVAILABLE VOICE COMMUNICATIONS RESOURCE.

WORD FRAME INTERRUPT (WFI)

BASIC MEASURE OF TIME IN THE TRUNKING SYSTEM; EQUIVALENT TO THE TIME OF AN OSW (23.3 mS).

GENERAL COMPUTER TERMS

HARDWARE - This is a term used to describe any of the physical embodiments of a computer system. Hardware items of a system include the CRT, circuit boards, CPU chip, etc. The hardware is totally useless without software!

PROGRAM - A sequence of instructions that the hardware (computer) executes. A program is the interface between the user and the machine. For example, without the Guardian program the System Manager's terminal is totally useless. These instructions are written by a programmer and can be in a variety of languages. Machine language is the most elemental and is referred to as low level language. FORTRAN, BASIC and COBOL are high level languages. Between these two extremes is Assembly Language. A program is software.

Programs are sometimes divided further into routines and subroutines. The System Manager's terminal program is called Guardian and it is made up of routines Auth, Subs, Bill, etc. Auth contains subroutines as does Bill, etc.

SOFTWARE - A general term that describes a program or group of programs that a computer uses. The software the System Manager's terminal uses is Guardian. The software used to write this on my computer is Superscript. It is the hardware (memory) that holds the software. The programs (software) are stored in memory chips in the CSC, TSC, RSC, etc. The Guardian program is stored in the CSC.

STATIC RAM - Random access read/write memory that is volatile. It must be backed up by a battery if it is to keep its memory if power is lost.

DRAM - Dynamic Random Access Memory. Also a random access read/write memory. It is volatile and must be backed up by a battery. However, its method of operation is different from that of static RAM.

Dynamic Ram must be refreshed constantly. It can hold its memory for typically 2 milliseconds. Dynamic RAM is used in the CSC, MCB, TSC, and RSC. It is a high density, fast memory.

ROM - Read Only Memory. This is memory that can only be read out of. It is non-volatile. Information is put into it only once and that's when it is manufactured.

PROM - Programmable Read Only Memory. In a system, these can only be read out of. Generally fusible link or diode matrix memories. These are programmable by the user just once and are non-volatile. There are ways of working around this "just once" thing but it's not for the average user.

EPROM - Erasable Programmable Read Only Memory. These are programmable electrically and are erased by ultraviolet light. They can be identified by a quartz window that is covered by a sticker. They are non-volatile and can only be read from.

EEPROM - Electrically Erasable Programmable Memory. This is an electrically programmable memory that is also non-volatile. It can be erased by applying a current to it. This is the memory we use in the Smartnet mobiles. This type of memory is sometimes known as EAPROM - Electrically Alterable Programmable Read Only Memory. These can be referred to as read/write memories.

FIRMWARE - Memory chips that contain software or programs. Firmware can be EPROMs, PROMs, or EAPROMs that contain an operating program (software) that the system can read.

Now let's see if we can put this whole business together. The Central Site Controller's hardware consists of the circuit boards, wiring, cables, power supply, cabinet, and the System Manager's terminal. Without software to run this hardware, it is a foundation of an expensive junkyard. To get this system to run we need to plug in the firmware.

The firmware is memory chips into which the operating program is stored. Guardian is an example of a stored program. Some of the routines that make up Guardian are: ENA, BILL, TELL, etc.

ERLANG

From Telephone's Dictionary, Telephone Publishing Corporation, 55 East Jackson Blvd., Chicago, Illinois, 60604.

"An international (dimensionless) unit of average traffic intensity (occupancy) of a facility during a period of time, normally a busy hour. The number of erlangs is the ratio of the time during which a facility is occupied (continuously or cumulatively) to the time the facility is available. Syn: Traffic Unit"

SUGGESTED READINGS

Wilkinson, Roger I.: Theories for Toll Traffic Engineering in the U.S.A., Bell System Technical Journal, March, 1956. pp. 421-514.

Palm, Conny: "Table of the Erlang Loss Formula," 3rd Edition, Kungl. Telestyrensen, Stockholm, 1964h^A^Q^I^T

CENTRAL CONTROLLER

BASIC TRUNKING CONCEPTS and SIGNALLING

Trunking Introduction

I. Trunking Definition

A. Trunking is an FCC classification of Specialized Mobile Radio Service (SMRs).

B. Old telephone company term/technique that means, "Automatic sharing of a small number of communications paths among a large number of users."

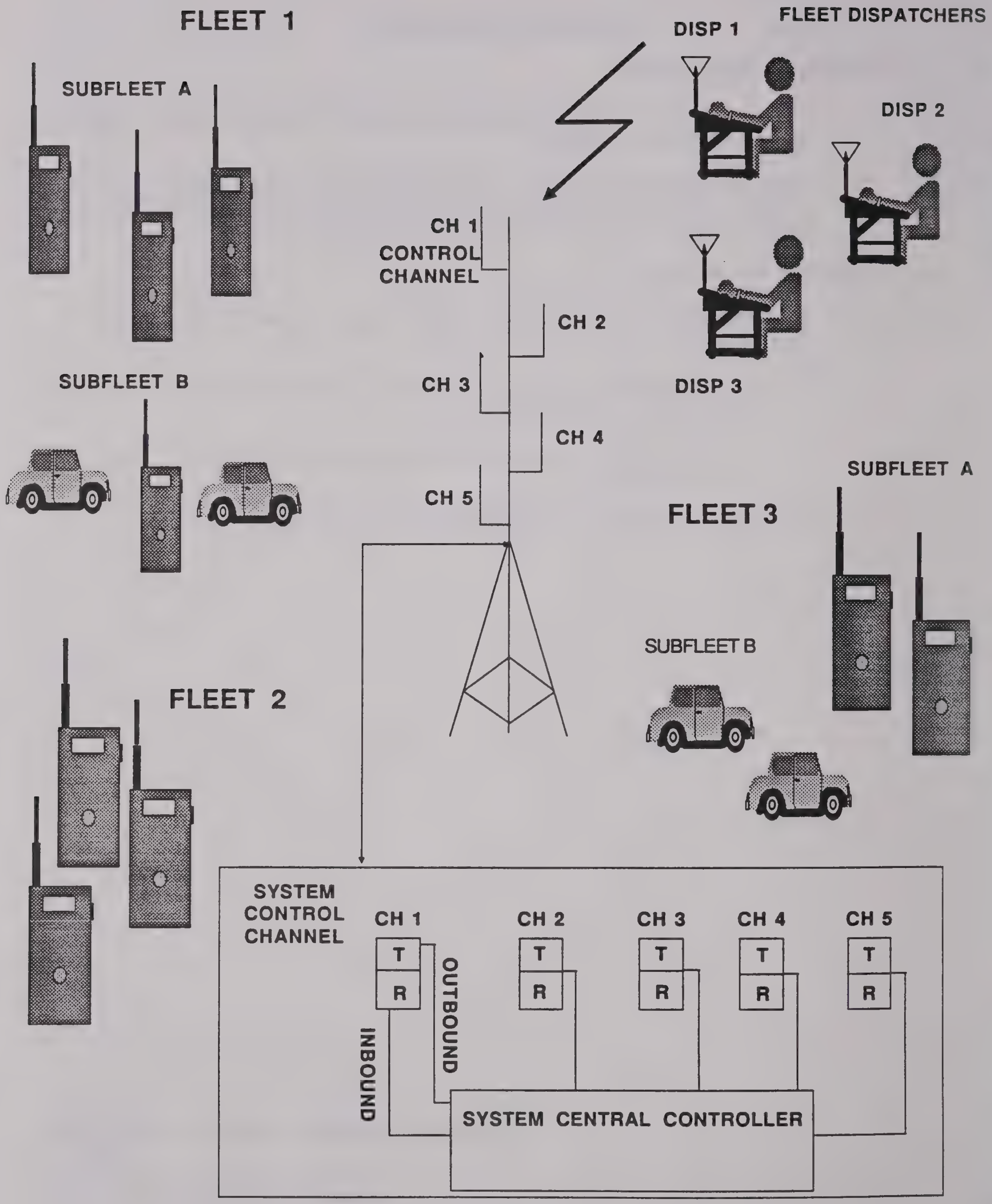
II. Loading criteria

A. FCC considers 100 subscribers (users) per channel as standard.

   1. This means that a 5 channel system would be loaded with 500 subscribers.

   2. A 20 channel system would be loaded with 2,000 subscribers.

B. Channels can also be added individually.


FLEET 1
SUBFLEET A
SUBFLEET B
FLEET DISPATCHERS
DISP 1
DISP 2
DISP 3
CH 1
CONTROL
CHANNEL
CH 2
CH 3
CH 4
CH 5
FLEET 3
SUBFLEET A
SUBFLEET B
FLEET 2
SYSTEM
CONTROL
CHANNEL
CH 1
CH 2
CH 3
CH 4
CH 5
T
R
OUTBOUND
INBOUND
SYSTEM CENTRAL CONTROLLER

TYPICAL SYSTEM

FIG. 1-2

III. The System Central Controller

A. Control Tasks:

1. Monitoring and controlling each call sequence: Has call been received? Is a voice channel available? Has a channel assignment been made? Has the originating radio acknowledged the channel assignment?

2. Monitoring voice channel activity (is a particular channel available for reassignment?).

3. Selecting and assigning vacant channels as required.

4. Controlling base repeater stations:

    a). Keying the repeaters when assigned.

    b). Rotates the control channel frequency on a daily basis so as to equalize equipment aging.

5. Provide a system manager interface through an optional keyboard terminal.

6. Monitoring and reporting of alarm conditions.

B. Receive Tasks:

RSC
1. Recovery and decoding of inbound signaling requests (subscriber unit originated service requests).
2. Monitoring and reporting of alarm conditions.

C. Transmit tasks: TSC

1. Generating and encoding outbound signaling words for such purposes as directing system users to specific channels.
2. Generating the sub-audible data which is superimposed on all voice communications and is used to unmute the audio circuitry in receivers authorized to monitor the communications.
3. Generating the base station identification. lowest freq
4. Monitoring and reporting of alarm conditions.

D. System Central Controller Programming

A limited amount of system central controller programming is required. This programming will be done by the factory which will require the following customer supplied information prior to shipment.

1. RF channel identifiers - the identity of each channel frequency and the repeater position assigned to it in the trunked system must be programmed into the system central controller.

2. Base station identification - the system call sign is automatically transmitted in morse code once every 30 minutes in compliance with FCC regulations. The alphanumeric system identification must be programmed into the system central controller. (This is sent in Morse Code at 17 WPM and 900 Hz tone modulation).

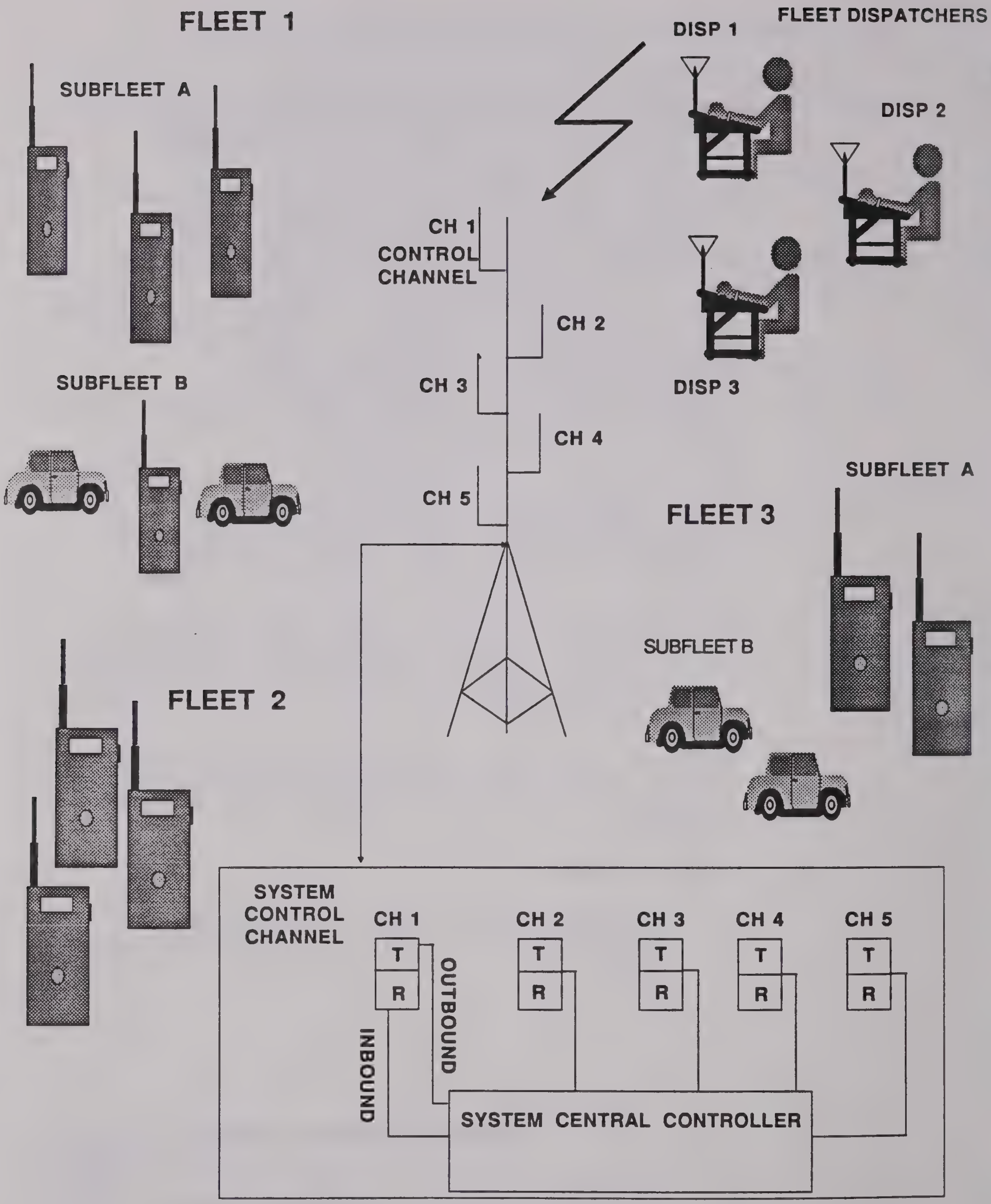
3. B.S.I. Channel - the identity of the channel over which the base station identification is transmitted must be programmed into the system central controller. The lowest available frequency of the trunked group will be used.

4. System control channels - the identity of those channels in the trunked group which can be used for the system control channel must be programmed into the system central controller. Four channels are so designated.

5. Autotest - Automatic midnight rollover - the Central Controller resets and does a complete diagnostic test vice just rotating the control channel.

6. Type of trunking:

    a. Transmission trunking - no hang time.
    b. Message trunking - has a programmable hang time.


FLEET 1
SUBFLEET A
SUBFLEET B
FLEET 2
FLEET DISPATCHERS
DISP 1
DISP 2
DISP 3
CH 1
CONTROL
CHANNEL
CH 2
CH 3
CH 4
CH 5
FLEET 3
SUBFLEET A
SUBFLEET B
SYSTEM
CONTROL
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CH 1
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OUTBOUND
INBOUND
SYSTEM CENTRAL CONTROLLER

TYPICAL SYSTEM

FIG. 1-2

IV. **Base Station Repeaters**

A. Description - 800 MHz "Trunked" base station repeater.

B. Ratings - 35, 70, 125 (Micor) 35, 75, 150, (MSF 5000) Watts of RF power at continuous duty ratings.

C. Frequency assignments

1. Channels are normally issued in blocks of 5 with 20 being the maximum.

    a. Standard channel spacing is 25 KHz.

    b. Maximum Deviation is 5 KHz. (Voice + Data.)

    c. Trunked channels begin with 854.7625 MHz (FCC channel # 151) and end with 869.9875 MHZ (FCC 760). Conventional frequencies from FCC #1 to #150 can be used if not previously allocated.

2. Each repeater in a block is 1 MHz apart from the other.

800 MHZ BAND ALLOCATIONS

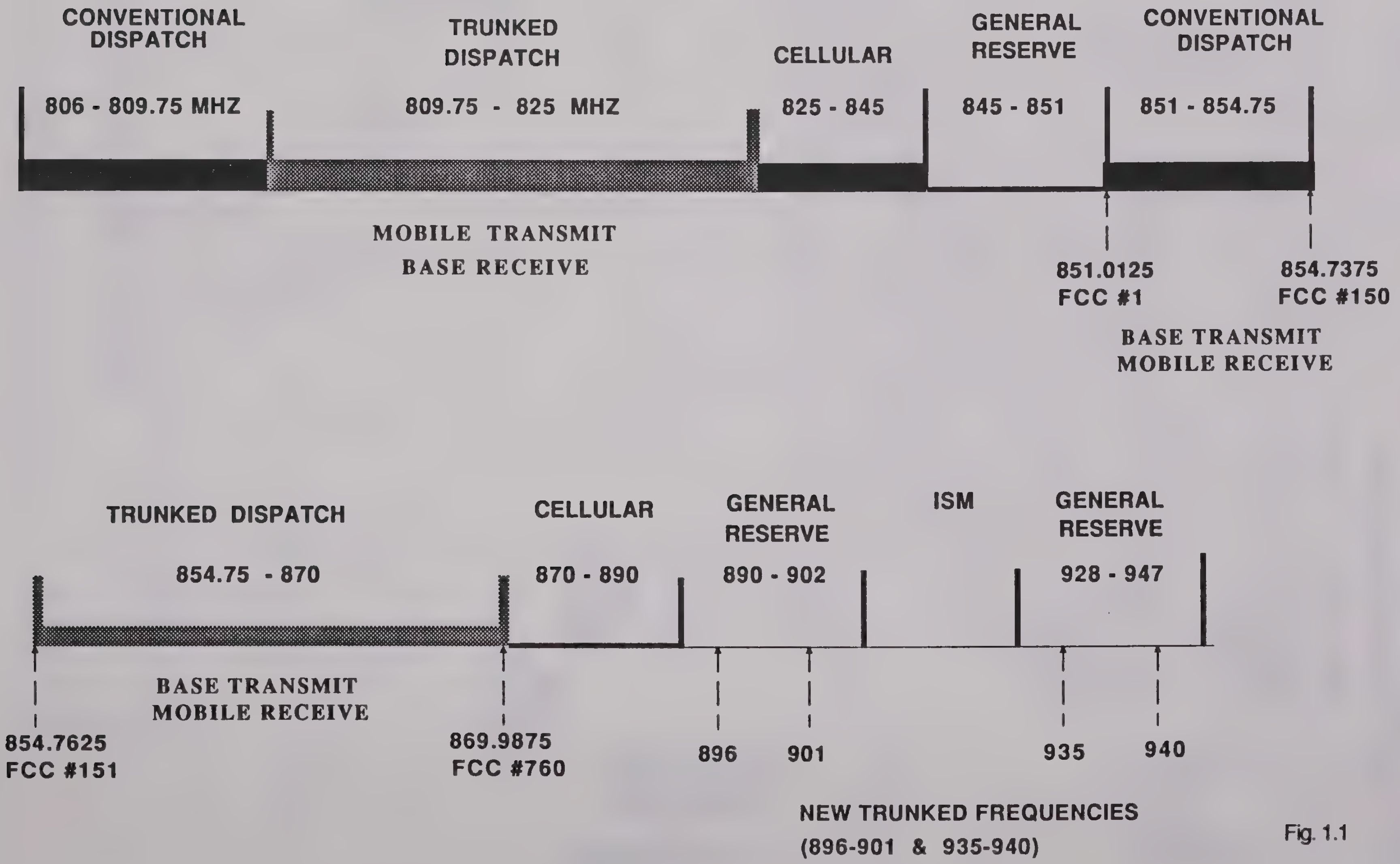

CONVENTIONAL DISPATCH
806 - 809.75 MHZ
TRUNKED DISPATCH
809.75 - 825 MHZ
CELLULAR
825 - 845
GENERAL RESERVE
845 - 851
CONVENTIONAL DISPATCH
851 - 854.75
MOBILE TRANSMIT
BASE RECEIVE
851.0125
FCC #1
854.7375
FCC #150
BASE TRANSMIT
MOBILE RECEIVE
TRUNKED DISPATCH
854.75 - 870
CELLULAR
870 - 890
GENERAL RESERVE
890 - 902
ISM
GENERAL RESERVE
928 - 947
BASE TRANSMIT
MOBILE RECEIVE
854.7625
FCC #151
869.9875
FCC #760
896
901
935
940
NEW TRUNKED FREQUENCIES
(896-901 & 935-940)

Fig. 1.1

FCC 800 MHZ ALLOCATIONS

FCC Channel Number	Motorola Channel Number	Repeater Tx Frequency	Repeater Rx Frequency
Conventional Frequencies			
1	0	851.0125	806.0125
2	1	851.0375	806.0375
148	147	854.6875	809.6875
149	148	854.7125	809.7125
150	149	854.7375	809.7375
Trunked Frequencies			
151	150	854.7625	809.7625
152	151	854.7875	809.7875
153	152	854.8125	809.8125
273	272	857.8125	812.8125
274	273	857.8375	812.8375
275	274	857.8625	812.8625
276	275	857.8875	812.8875
420	419	861.4875	816.4875
421	420	861.5125	816.5125
458	457	862.4375	817.4375
459	458	862.4625	817.4625
460	459	862.4875	817.4875
461	460	862.5125	817.5125
462	461	862.5375	817.5375
499	498	863.4625	818.4625
500	499	863.4875	818.4875
501	500	863.5125	818.5125
539	538	864.4625	819.4625
540	539	864.4875	819.4875
541	540	864.5125	819.5125
580	579	865.4875	820.4875
581	580	865.5125	820.5125
756	755	869.8875	824.8875
757	756	869.9125	824.9125
758	757	869.9375	824.9375
759	758	869.9625	824.9625
760	759	869.9875	824.9875

D. Types of Assignments:

1. Control channel - one of four highest frequencies used to transmit and receive data.

    a. Used by the central controller to transfer channel assignment data or other control commands to user

        1). The base station with the least amount of key up time is chosen as the next system control channel and is always keyed while assigned.

    b. All data words on the control channel contain sufficient information to address particular radio units and specify actions to be taken.

    c. This information is assembled into a coding format which has sufficient error correction and detection capability to ensure reliable communications.

    d. This encoded binary data is passed to the transmitter at 3600 baud where it is filtered and impressed on the carrier.

177 us bit x background 84 bits = WF1 23.3ms

8 sync - 27 info - 49 bits error correction
addr+coding
sims-diag
grants -
16 adr 10 data
1 bit call type

D. BASE STATION ASSIGNMENT CON'T.

2. Voice channel - used to transfer normal voice data.

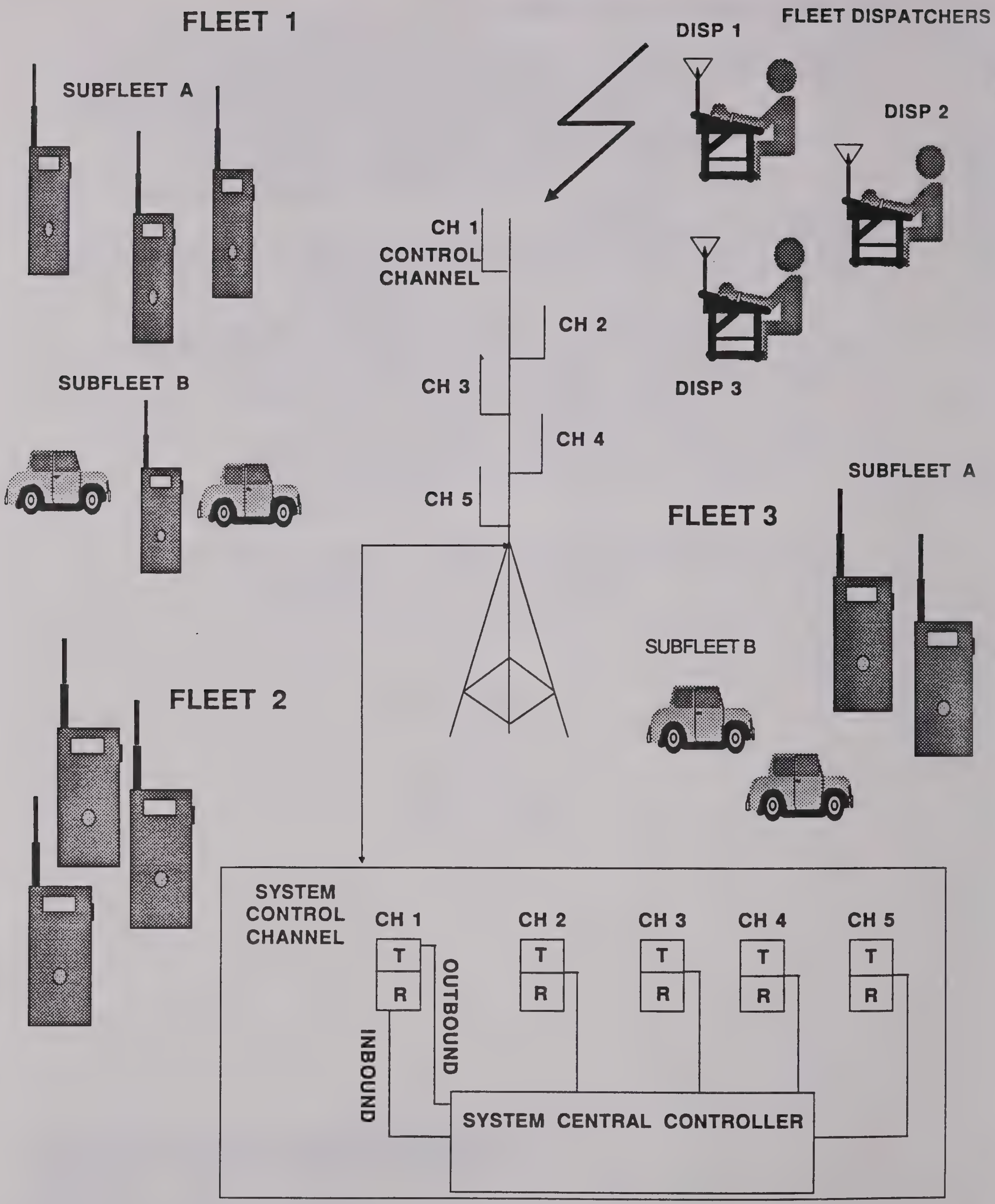
   a. The selection of voice channels for assignment will be made in a numerical sequence based on the next highest frequency available.

      1). Voice channels are only keyed up when needed.

      2). Voice channel key up times are tabulated by the central controller.

   b. Continuous sub-audible tones accompany all mobile or portable originated transmissions.

   c. Base to mobile transmissions contain a sub-audible digital signal.


FLEET 1
SUBFLEET A
SUBFLEET B
FLEET DISPATCHERS
DISP 1
DISP 2
DISP 3
CH 1
CONTROL
CHANNEL
CH 2
CH 3
CH 4
CH 5
FLEET 3
SUBFLEET A
SUBFLEET B
FLEET 2
SYSTEM
CONTROL
CHANNEL
CH 1
CH 2
CH 3
CH 4
CH 5
T
R
OUTBOUND
INBOUND
SYSTEM CENTRAL CONTROLLER

TYPICAL SYSTEM

FIG. 1-2

V. Subscriber units

A. Definition - Mobiles, portables, control stations

B. Simplified operation

1. Elimination of squelch control and the need for channel monitoring before transmitting.

2. If the system is busy, the mobile will produce a busy tone.

3. When a channel becomes available, the mobile will produce a talk permit tone.

C. Code plug contents:

1. System ID
2. Fleet ID
3. Individual ID
4. Subfleet table structure
5. Channel pairing table
6. Fail soft channel
7. Talk permit tone flag (optional)
8. Time-out timer
9. Control channel frequency assignments

D. Trunking Logic Circuitry

1. The digital data transferred over the system control channel links subscriber unit to central controller.

2. Some of the functions performed by the subscriber units trunking logic circuitry are:

   a. Seeks out and remembers the identity of the system control channel.

   b. Upon activation of the microphone PTT button, the mobile encodes and transmits inbound service requests to the system central controller.

Type II 700001

   c. Automatically switches to receive mode to decode and respond to outbound commands sent by the system central controller.

   d. Automatically changes the subscriber units channel.

   e. Generates sub-audible connect tone to maintain the system connection.

   f. Controls radio time-out timer.

3. Upon command from the central controller, the subscriber unit will:

   a. Generate and sound alert tones.

   b. Enable and disable it's transmitter.

   c. Mute and unmute it's transmitter audio.

   d. Mute and unmute it's receive audio.

Trunking - General Quiz 1

1. a. What is the maximum amount of deviation permitted in the 800 MHz trunking band? ±5.0 khz

   b. What is the amount of channel spacing in the trunking band? 25khz

Questions 2 - 5 pertain to a 5 channel trunking system that has Motorola channel numbers 420, 460, 500, 540, and 580. Local channel numbers assigned with #1 being the highest frequency and #5 being the lowest.

2. What is the FCC channel number for the repeater that has Motorola number 500? 501

3. What is the channel number within your system (1-5) of the repeater that has FCC channel number 421? 5

4. What frequency is system repeater number 5 transmitting on?
861.5125

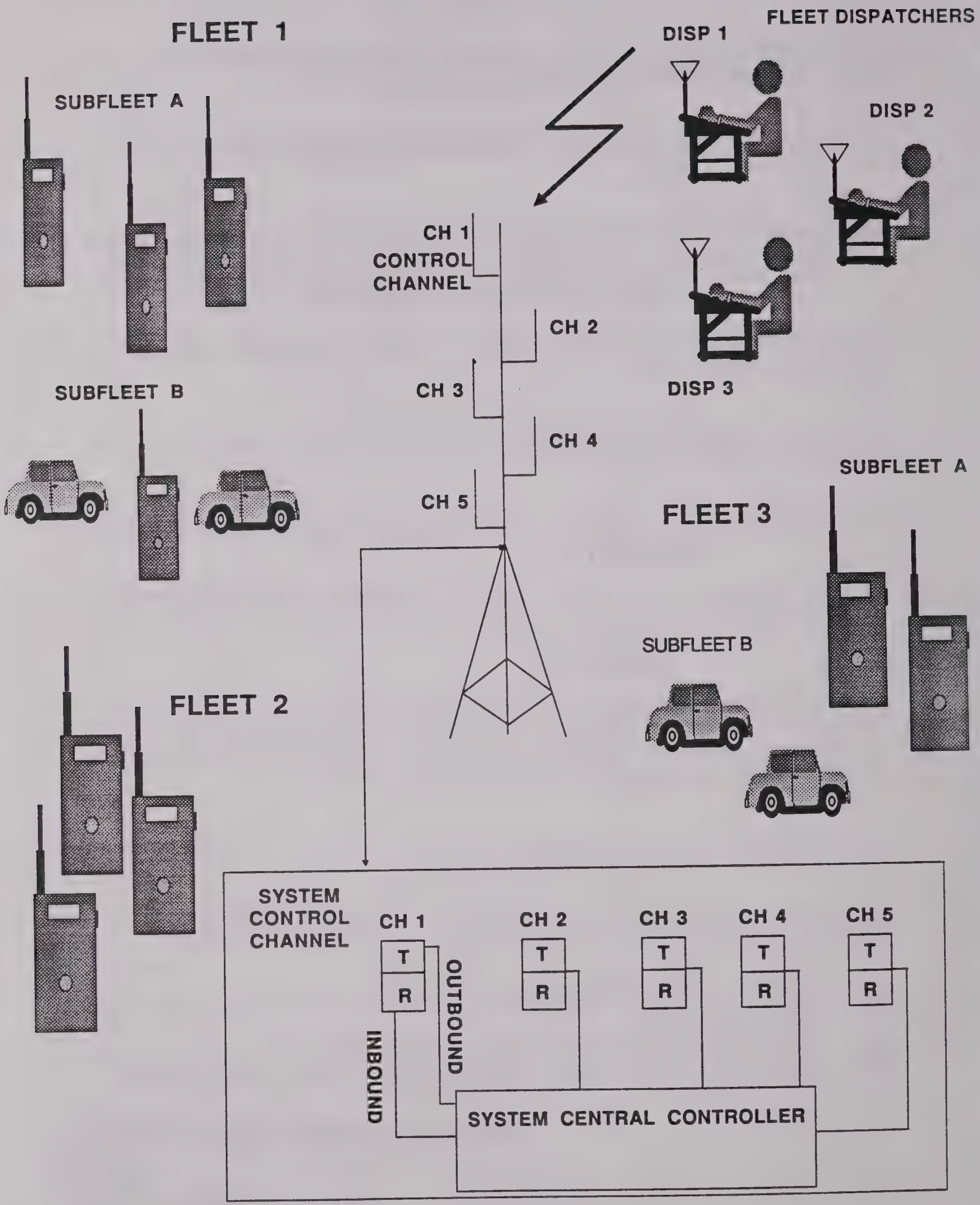
5. What frequency would you set your communications monitor to generate if you wanted to test the receiver in the repeater with a Motorola number of 460?
817.5125

6. During normal operation of the above trunking system, you notice that the repeater with the Motorola number of 420 is never assigned as a control channel. What troubleshooting steps would you perform and in what order?
none

7. How many units does the FCC consider to be on a fully loaded 10 channel trunked system? 1000

8. In setting up your test bench for testing 800 MHz radios, which of the following statements is the most true?

   a. A dummy load should never be used.
   b. Static is never a concern with cmos chips used in a well shielded radio.
   c. Test cables should have as many connectors as possible.
   [✓ d.] Double-shielded coax should be used for test cables.


FLEET 1
SUBFLEET A
SUBFLEET B
FLEET DISPATCHERS
DISP 1
DISP 2
DISP 3
CH 1
CONTROL
CHANNEL
CH 2
CH 3
CH 4
CH 5
FLEET 3
SUBFLEET A
SUBFLEET B
FLEET 2
SYSTEM
CONTROL
CHANNEL
CH 1
CH 2
CH 3
CH 4
CH 5
T
R
T
R
T
R
T
R
T
R
OUTBOUND
INBOUND
SYSTEM CENTRAL CONTROLLER

TYPICAL SYSTEM

FIG. 1-2

VI. System Capabilities

A. Types of Trunking

1. Transmission Trunking

   a. All transmission trunked calls must be initiated through the control channel and will not be processed until all members of the group have returned to the control channel.

   b. The central controller will disconnect the voice channel immediately after detecting a disconnect signal from the transmitting unit.

   c. The radios will mute and immediately return to the control channel.

   d. Transmission trunked calls have no hang time.

   e. The entire assignment procedure will be repeated for a unit responding to the original call and transmissions will generally be assigned to a different channel.

   f. Advantages of Transmission Trunking:

      1). Transmitting mobile's individual ID is always known by the central and logger.

      2). Has the capability to inhibit new call requests within the group.

   g. Disadvantages of Transmission Trunking:

      1). Transmission trunked calls and all calls in conversation with them must return to the control channel before talking on a voice channel. This increases the chance of a mid-conversation busy.

2. Message Trunking

   a. 0.1-6 seconds time out (hang time).

   b. In a message trunked system, system and fleet wide calls will become transmission trunked calls.

2. Message Trunking (Continued)

c. When a message trunked call is in progress, other units within the same group are allowed to key without returning to the control channel.

d. Operation can continue on the voice channel as long as the time out timer (TOT) is not allowed to expire.

e. When time out does occur, the central controller disconnects the radios from the channel by sending a low speed disconnect word on the voice channel (300 baud at low deviation for 125 mSec).

f. The radios will mute and return to the control channel when disconnect is detected.

g. The channel becomes available for reassignment by the central controller for other uses.

h. Advantages of Message Trunking:

1). Allows for very smooth transition from one mobile to another which will allow a complete conversation to take place on one voice channel without getting mid-conversation busies.

i. Disadvantages of Message Trunking:

1). Since the voice channel can get transferred from one mobile to another, the individual ID of the mobile transmission may be unknown, unless you have the Push-To-Talk ID feature for your system.

B. Types of Call Capabilities

1. System Call

a. Operation:

1). Dispatcher requests a system wide call.

2). Any active subfleet calls in progress in a message trunked system are changed to transmission trunked.

3). Requesting unit is given a busy until subfleet voice traffic clears

4). All FLEETS are assigned to one voice channel.

5). A system wide call is transmission trunked and ends when the dispatcher un-keys.

b. Notations:

1). Emergency calls, private conversations (PC) and interconnect calls are not affected by systemwide calls.

2). Any subfleet call requests in busy queue are dropped.

2. Fleetwide Calls/Announcement Group (multi)

a. Operation:

1). Fleet manager requests a fleet wide call.

2). Call set-up same as system wide for fleetwide calls.

b. Notations:

1). Emergency calls, PC, and interconnect calls are not affected.

2). All subfleet call requests in busy queue for that **fleet** are dropped.

3. Subfleet call

a. Fleets are divided into subfleets.

b. Radios assigned to a given subfleet will be provided with a subfleet call capability.

c. These radios will be able to communicate with other members of the same subfleet.

B. Types of Call Capabilities (Continued)

4. Multiple subfleet select (optional)

   a. The capability of allowing radios in the same fleet to selectively move between subfleets of that fleet is provided in the form of an optional radio selector switch.

   b. The dispatcher,(and select mobiles or portables) can be given both fleet call and subfleet call capabilities by means of the same optional selector; utilizing the same selector switch.

VII. **System Reliability Features**

A. Multiple channels

1. Channels are assigned as needed so users are not dependent on any given channel for communications.

2. The failure of any given channel would not be apparent to the user.

B. Back up control channels

1. If a control channel fails,the Central Controller is programmed to assign another repeater as a control channel.

2. Any of the highest four frequencies in a Motorola trunked system is eligible for assignment as a control channel.

3. The control channel is rotated daily among these four channels.

C. Receiver interference – RSTAT – unsquelch ind

1. The Central Controller is programmed to make repeaters unavailable for assignment for a specified timeout period when a carrier is detected on repeaters that have not been assigned as a voice channel.

MSF5000

Micor
Fwd
Ref
KeyAn

Fwd
Ref
Tact
RW3SYN Clock

D. Transmitter power failure and SWR shutdown ~TSTAT >.7v

1. If the output power decreases or fails, the Central Controller is programmed to detect it, and will not assign the faulty repeater until the problem is corrected.

2. The same sequence will occur if the SWR exceeds a predetermined level.

E. System self diagnostics

1. The system Central Controller has the capability to diagnose problems.

2. Checks performed are Central Controller integrity, repeater receiver and transmitter interface checks.

3. The results of the checks can activate visual or audible alarms.

4. Major/Minor relay contacts on the back plane of Central Controller activate these alarm systems.

F. System Time-outs

1. Carrier Time-Out Period - Determines the time period for which an assigned voice channel remains unmuted and active, receiving only carrier and no Connect Tones. The timer can be activated after Disconnect Tone is detected by the Central Controller. 0.5s

2. Fade Time-Out Period - Determines the time period for which an assigned voice channel remains active, even though no tones or carrier are received. After the time-out timer expires, the channel is unassigned. The timer is activated after the Central Controller fails to detect Disconnect Tone after loss of the low speed connect tone. 1.2s

3. Message Trunk Time-Out Period - Determines the time period for which a voice channel remains active after receiving Disconnect from the mobile (repeater hang time). After the time-out expires, the channel is unassigned. 1s

4. Carrier Malfunction Time-Out Period - Determines how long an interfering carrier must be present on an unassigned channel before that channel is removed from system use. An entry of 254 seconds disables the time-out.
   50s

5. May be edited by the System's Managers Terminal utilizing the PARMs command.

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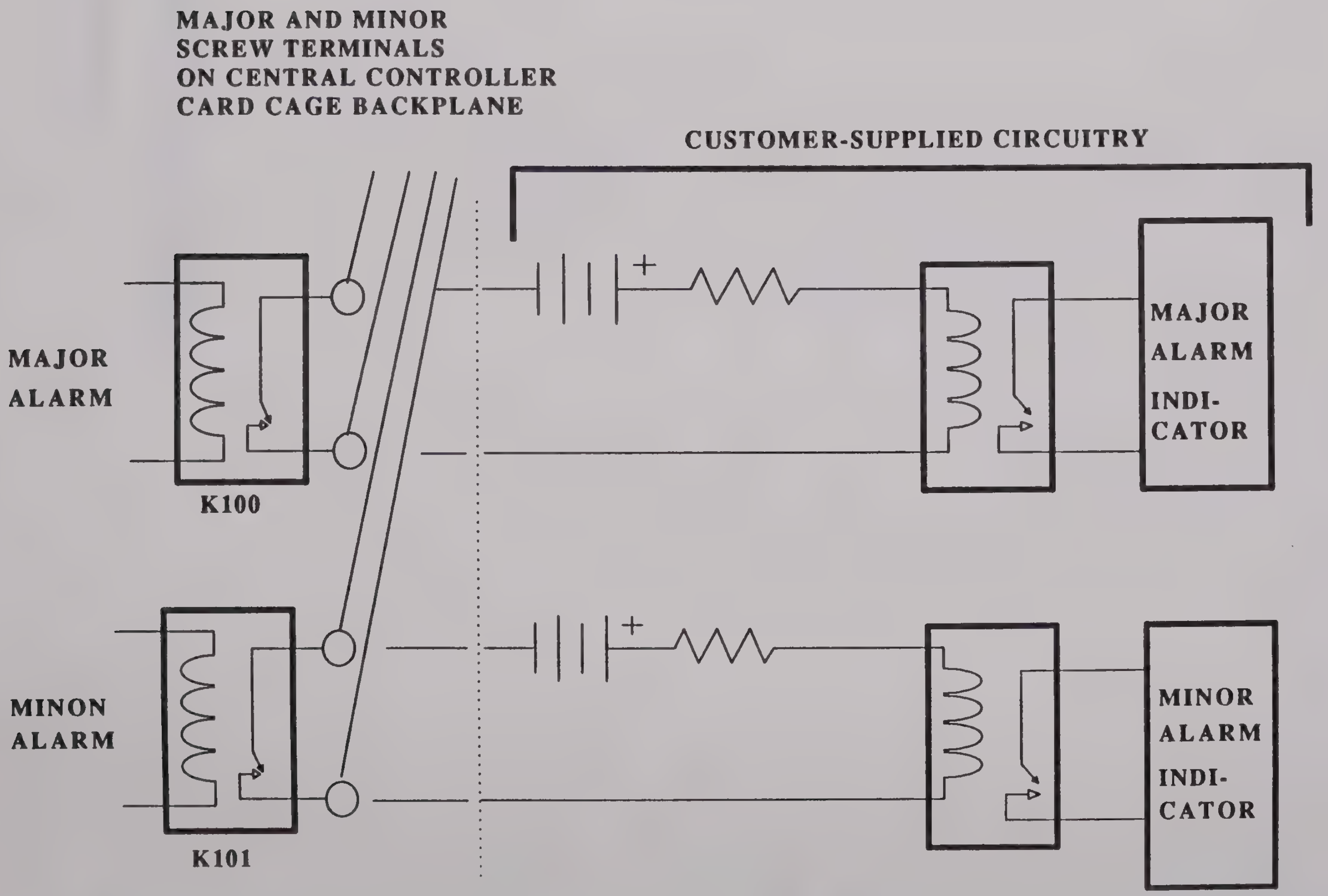
TYPICAL MAJOR AND MINOR ALARM CIRCUITRY


MAJOR AND MINOR
SCREW TERMINALS
ON CENTRAL CONTROLLER
CARD CAGE BACKPLANE
CUSTOMER-SUPPLIED CIRCUITRY
MAJOR ALARM
K100
+
MAJOR ALARM INDI- CATOR
MINON ALARM
K101
+
MINOR ALARM INDI- CATOR

NOTES:

1. DIAGRAM SHOWS ABSENCE OF ALARM CONDITION (BOTH RELAYS ARE ENERGIZED).
2. CENTRAL CONTROLLER DRY-CONTACT RELAY RATING-28V, 100 mA.

Fig. 1.2.0

G. **System Alarm Reporting**

1. Major and minor alarm indications can be generated by system self-diagnostics.

2. A dry contact relay closure (normally closed) is used to indicate normal non-alarm status

3. When the central site controller detects an alarm condition, one or both relays will open

    a. Relay closures may be used to operate any desired alarm indicating device

    b. Led indicators are located on the front panel to indicate alarm conditions to the individual board level

4. A major alarm may be set by either hardware or software controlled functions and would include the following:

    a. Failure of all control channel transmitters
    b. Failure of the site controller boards
    c. Failure of the inbound recovery board
    d. Failure of the central controller power supply
    e. Loss of AC power to the central site
    f. Any of the above would cause the system to go into "failsoft" operation

5. Minor alarms are software controlled and consist of the following:

    a. Failure of a tone detector on the receiver interface board
    b. Interference on a voice channel receiver
    c. Failure on a voice channel transmitter
    d. Interference on the control channel base receiver frequency

6. Major and minor alarms can be reset by activation of a momentary reset switch on the front panel of the central site controller.

7. Minor alarms can be reset through the system manager interface.

8. If alarm condition has been corrected, the alarm will not be reactivated

9. If alarm condition is still present, the alarm will be set once again

10. An alarm disable switch is provided on the front panel of the central site controller board to inhibit alarm reporting.

11. The front panel indicators can be tested by activation of the momentary indicator test button on the front panel of each site controller.

H. Misdirected radio protection

21 bits 150 baud

1. To make sure that no mobile from one subfleet can be accidentally assigned to a voice channel being used by another subfleet, a sub-audible data handshake has been implemented.

2. If a unit from a different fleet/subfleet were accidentally assigned the same channel, the radio would not recognize the outbound data and would revert to control channel.

3. Misdirected radio protection would only become a factor in the event that the outbound channel assignment was erroneously decoded.

I. Continuous assignment updating

1. Once a fleet or subfleet is assigned a voice channel, the control channel will continue to transmit the channel assignment for as long as the fleet is using the channel.

2. A radio just coming into service will be sent to the appropriate voice channel to join the rest of the fleet.

3. The assignment updates will be sent out by the Central Controller on the control channel.

J. Failsoft

1. If the system Central Controller is rendered inoperative, system mobiles revert to pre-assigned failsoft voice channels.

2. This results in conventional repeater operation on that channel.

    a. Fleet/Subfleet privacy will be lost.

3. To be sure the radios will not operate in failsoft when going out of range, a sub-audible data handshake is activated on each channel when repeaters go into failsoft.

    a. The units only become operative and stay operative as long as they receive the sub-audible failsoft data word.

    b. Mobile operator is informed of failsoft by the automatic sounding of an audible alert tone every ten seconds.

4. Failsoft channel assignments are a function of the mobile code plug programming.

VIII. System Access Features

A. Talk prohibit tones

1. Busy

   a. Any user keying up while all voice channels are busy will receive a busy acknowledge and lock into the the monitor mode. The radio will produce a busy tone until a voice channel is granted or the PTT is released.

2. Out of Range/Out of Service

   a. If a radio is out of range or the system is out of service, the mobile will generate a talk prohibit tone.

   b. The out of range tone is distinguished from the out of service tone by pulsing during the random retry time.

B. Talk Permit

1. An initiating radio that has the talk permit tone flag set in it's code plug will generate the tone whenever it goes to the assigned voice channel frequency.

2. Any user requesting system access, when all voice channels are busy, will be placed into a waiting list, called a queue, and be serviced on a First In / First Out (FIFO) basis. When a channel becomes available, the Central Controller will call you back.

3. The radio will produce a short series of three beeping tones to inform the user that his voice may now be transmitted.

C. Automatic retry

1. The radio units are designed to continue sending channel requests until the request is acknowledged by central, or until 4 seconds (16 tries) have elapsed.

   a. Operator does not need to continually key.

C. Automatic retry (continued)

b. Initial request may not be acknowledged because vehicle is out of range or because of poor signal reception.

c. Automatic retries are random to eliminate the possibility of contention on the control channel.

D. Multiple Priority Levels

1. Even on a trunked system, busy periods may occur that can effectively tie up all repeaters in the system. In order to provide immediate system access to the most critical service during busy periods, five different levels of user priority are available for all mobiles and portables.

2. Priority levels are numbered 1 through 5 with priority level 1 being given fastest access to the system; but it is reserved for Emergency call capability which is available only as an option of Smartnet software (not applicable to Privacy Plus). The other priority levels are acted upon by the central controller in numerical order from lowest to highest.

3. Except for level 1 (Emergency), names for the specific priority levels are assigned by the buyers or users of the system. These levels are entered by the System Manager's Terminal utilizing the Subscriber Access Command called "SUBS'.

4. Those individuals who have access to the system "SYSTEMS MANAGERS" terminal through physical access and password knowledge are the only ones who have the ability to assign and/or change priority levels. They are not controllable by a mobile or portable operator. These are software changes that implement special queuing on a continous basis through the Central Controller via the Control Channel.

E. Recent user priority.

   1. A recent user is a subscriber that previously had a voice channel assignment and timed out. Up to ten (10) seconds after timeout they will have priority over new users, with the same priority level.

   2. This ensures that a subfleet engaged in a message will get priority system access even if there is a delay between transmissions.

Trunking Data Formats

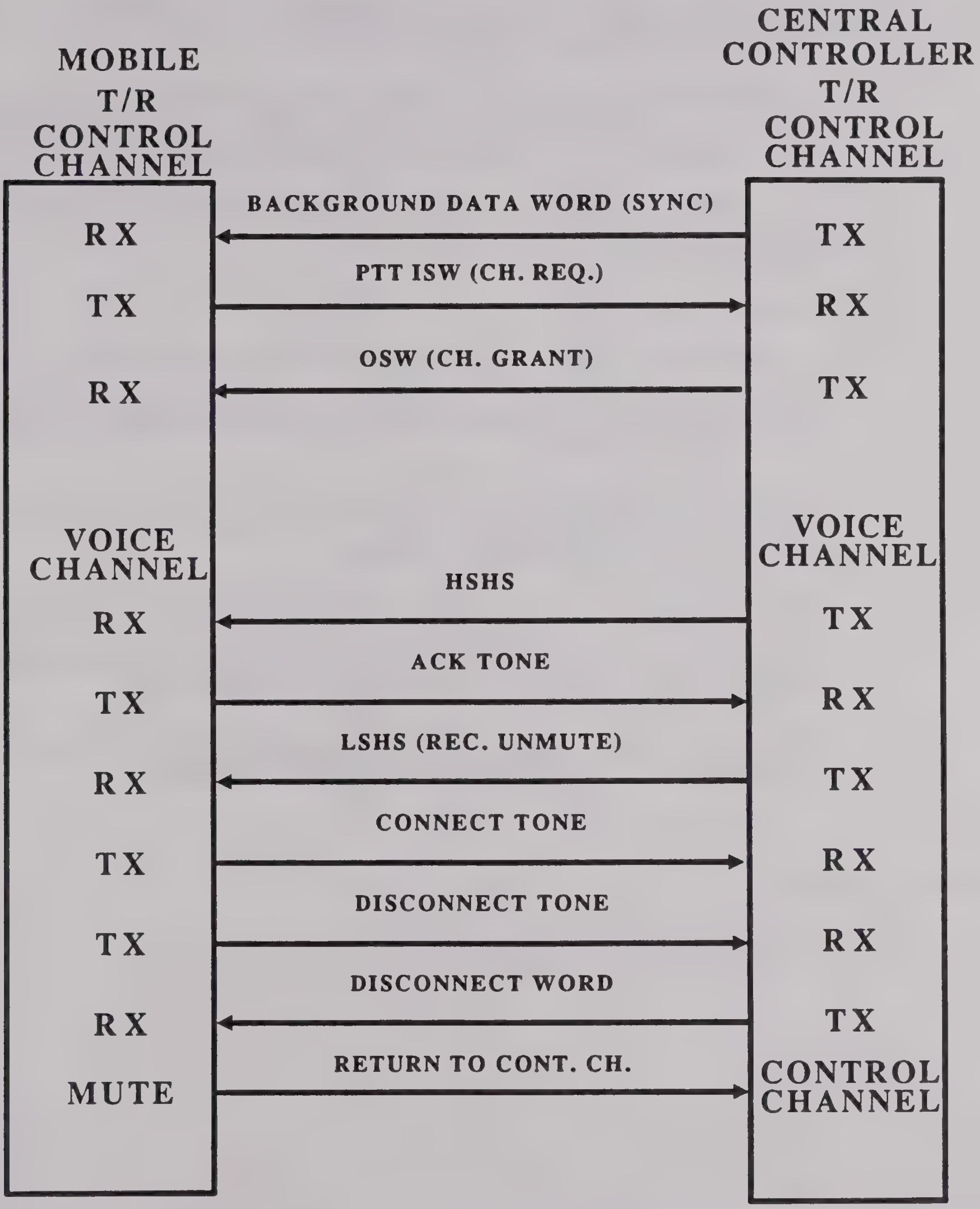
A. Outbound Signal Words (OSW's) within Word Frames

1. The Word Frame is a 23.3 mSecond time frame in which all outbound signalling words are transmitted.
2. All OSW's are 84 bits sent at 3600 bps (23.3 ms).
3. The first eight bits of an OSW are used for mobile and/or portable synchronization.
4. Background data word
    a. Sent continuously from the Central Controller.
    b. Normally contains 0B19DF00 - which tells the subscriber this is a Motorola system. It is used for bit sync only, no useful information for user.
5. System ID
    a. Contains system ID and control channel information.
    b. Inserted in the BDW serially at least once every three seconds.
6. Grant/Busy
    a. Contains prefix, fleet, subfleet, individual mobile ID, call type (CT), and voice channel assignment or status information.
    b. After requesting radio has sent acknowledge tone, the operator may be issued an "optional," audible indication so that he may talk.
        1). 187 mSec sequence of three "talk permit tones"

B. Inbound Signaling Word (ISW)

1. Sent from radio to controller.
2. 78 bits, sent at 3600 bps (21.67 ms) containing prefix, fleet, subfleet, individual ID and type of call requested.
3. ISW is directly dependent on settings of subfleet, call alert, private call and telephone switches.
4. ISW is transmitted synchronized to the Central Controller's OSW.

TYPE 1 TRUNKED SIGNALING SUMMARY


MOBILE T/R CONTROL CHANNEL
CENTRAL CONTROLLER T/R CONTROL CHANNEL
BACKGROUND DATA WORD (SYNC)
RX
TX
PTT ISW (CH. REQ.)
TX
RX
OSW (CH. GRANT)
RX
TX
VOICE CHANNEL
VOICE CHANNEL
HSHS
RX
TX
ACK TONE
TX
RX
LSHS (REC. UNMUTE)
RX
TX
CONNECT TONE
TX
RX
DISCONNECT TONE
TX
RX
DISCONNECT WORD
RX
TX
RETURN TO CONT. CH.
MUTE
CONTROL CHANNEL

X. Fleet Mapping

A. What is the fleet map for a system?

1. The fleet map is a software "code" stored in the Central Controller's non-volatile memory.

2. It determines how the central will interpret the 16 bits from an Inbound Signaling Word (ISW) which indicate who the originator is and which group he wants to talk to.

3. The same ID code is stored in each radio so they can properly decode Outbound Signaling Words (OSW) for that particular system.

B. Facts about fleets

1. A fleet is a roster of ID's. A radio initiating a call must use a roster ID to indicate who he is. Every radio needs at least one exclusive roster position to be a part of the system.

2. If a radio needs the ability to participate in different fleets at different times, a roster position must be reserved for it in each fleet.

3. The trunking ID of a radio (personality) is a function of the fleet it is currently switched to and its roster position in that fleet. If a radio switches fleets, it changes its trunking ID and it's attributes.

4. If a radio only switches between subfleets all in the same fleet, its trunking ID never changes.

Visual fleet Map

Fleet 001	Fleet 002	Fleet 003	Fleet 004
001. ______	001. ______	001 ______	001. ______
002. ______	002. ______	002. ______	002. ______
003. ______	003. ______	003. ______	003. ______
004. ______	004. ______	004. ______	004. ______
005. ______	005. ______	005. ______	005. ______
006. ______	006. ______	006. ______	006. ______
007. ______	007. ______	007. ______	007. ______
008. ______	008. ______	008. ______	008. ______
009. ______	009. ______	009. ______	009. ______
*	*	*	*
*	*	*	*
*	*	*	*
*	*	*	*
*	*	*	*
*	*	*	*
010. ______	010. ______	010. ______	010. ______

** Matrix position 002-4 IS a unique position

** Both a fleet and roster position are needed to form a unique trunking ID

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prefix fleet sub individual

1 2 3|4 5 6 7 8 9 10|11 12|13 14 15 16

0 0 0 0 0 0 0 0 0 1 0 1 0 0 0 0

Fleet map choices
ID's, subfleets per fleet

Eight weighted total points allowed per system

Size code (Prefix)	weighted points	fleets	subfleets per fleet	max unit ID's per fleet
A^1	1	128	3	16
B^1	1	16	7	64
C^1	1	8	7	128
D^1	1	1	15	512
E	1	64	3	32
F	1	32	7	32
G	1	32	3	64
H	1	16	3	128
I	1	8	3	256
J	1	4	7	256
K	1	2	15	256
M	2	1	15	1024
O	4	1	15	2048
Q	8	1	15	4096
X	type II sizecode			

A^1, B^1, C^1, and D^1 are existing fleet types that are standard -- (2) each per system.

(EXAMPLE) SYSTEM #: 0818

SYSTEM NAME: NST 0818

PREFIX/SIZECODE MAP

FLEET PREFIX	SIZE CODE	MAX FLEETS	MAX UNITS/FLEET	MAX SUBS/FLEET
0	A	128	0016	03
1	A	128	0016	03
2	B	016	0064	07
3	B	016	0064	07
4	C	008	0128	07
5	C	008	0128	07
6	D	001	0512	15
7	D	001	0512	15

FLEET MAP TYPE I

Size Code	Prefix	# of Fleets	# of Sub-Fleets	# of Units per Fleet	Weight Points	# of ID 's Per Block
C	0	8	7	128	1	1024
C	1	8	7	128	1	1024
D	2	1	15	512	1	512
D	3	1	15	512	1	512
O	4	1	15	2048	4	2048

BLOCK 1
FLT000 - FLT007

BLOCK2
FLT100 - FLT107

BLOCK 3
FLT200

BLOCK 4
FLT300

BLOCK 5
FLT400

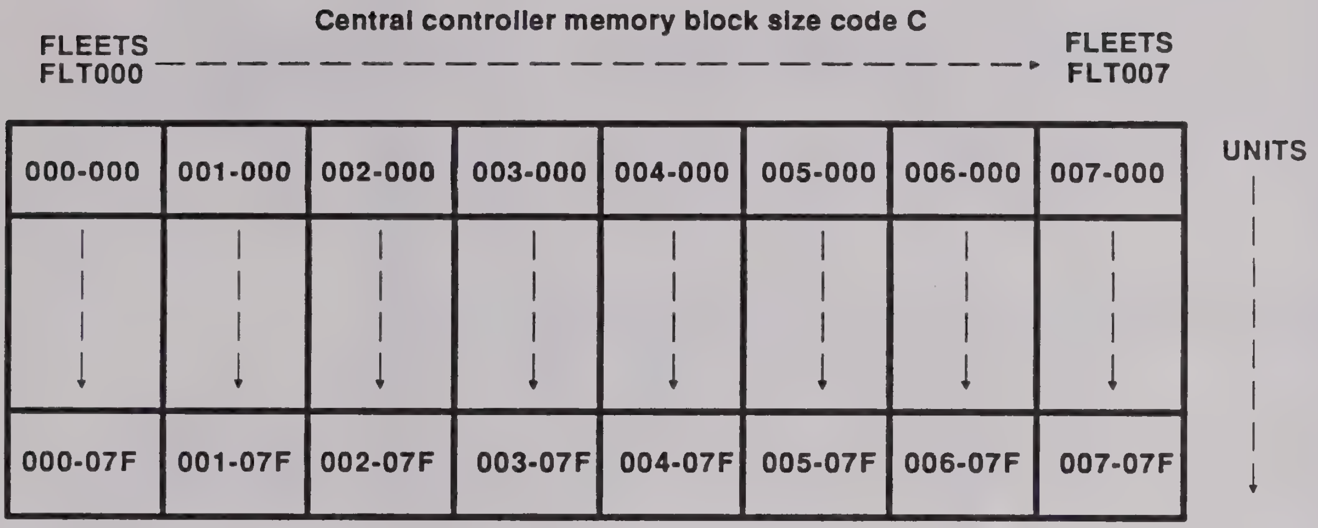
BLOCK 6
FLT400

BLOCK 7
FLT400

BLOCK 8
FLT400

Fig. 1.3

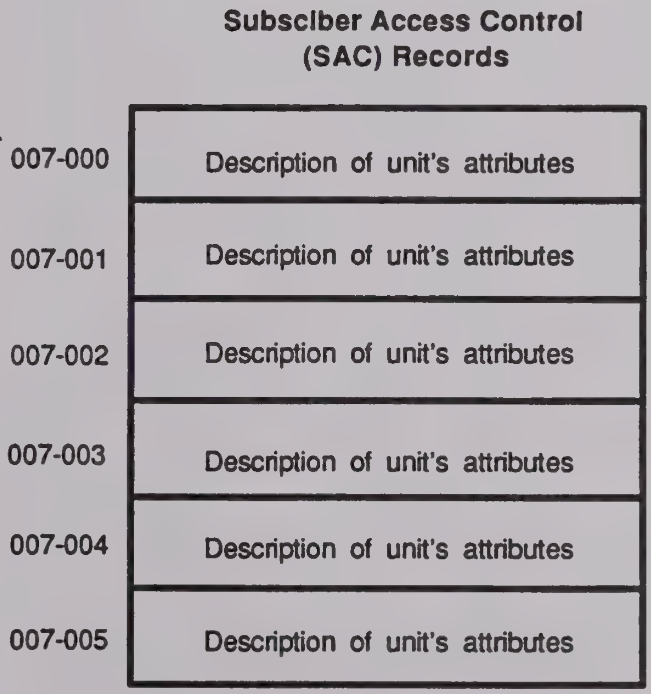
FLEET MAP TYPE I


Central controller memory block size code C
FLEETS FLT000
FLEETS FLT007
UNITS
000-000
001-000
002-000
003-000
004-000
005-000
006-000
007-000
000-07F
001-07F
002-07F
003-07F
004-07F
005-07F
006-07F
007-07F

Both fleet ID and individual ID make a unique trunking ID.

eg. 007-000

That unique ID is associated with a specific position in the SAC records.

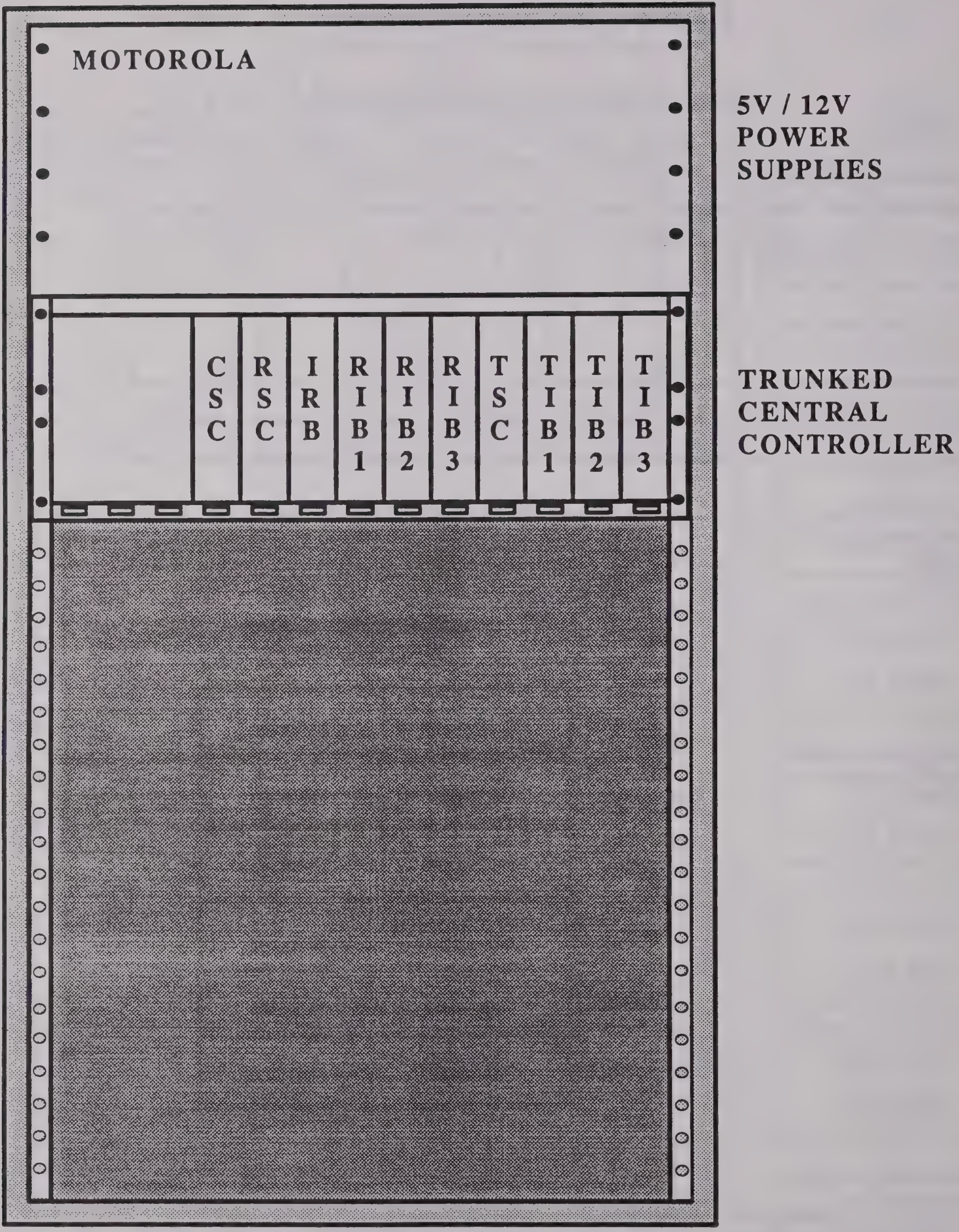

Subsciber Access Control (SAC) Records
007-000
Description of unit's attributes
007-001
Description of unit's attributes
007-002
Description of unit's attributes
007-003
Description of unit's attributes
007-004
Description of unit's attributes
007-005
Description of unit's attributes

007-000

Description of unit 007-000's attributes listed in SAC record

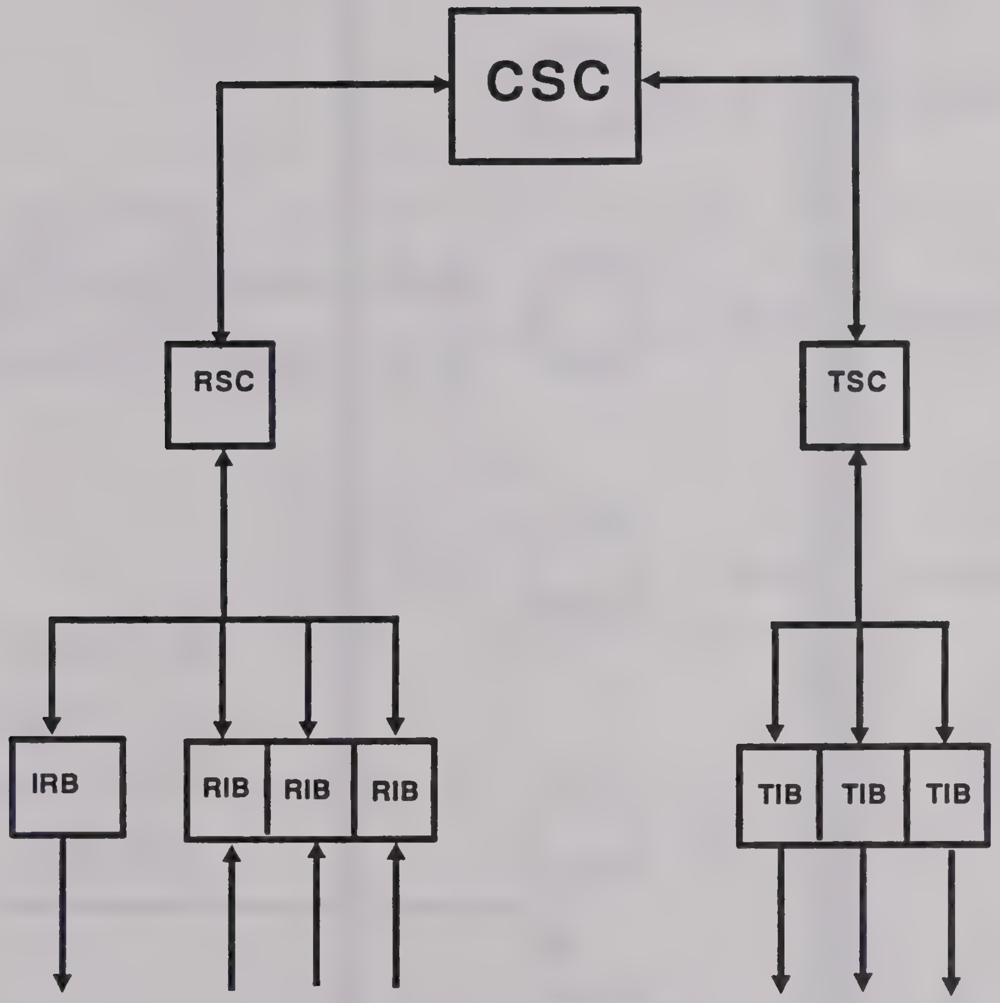
FLT	UNT	ENA	5CH	PTI	AMX	SYW	FLW	SBW	PVC	INT	DRG	PRL
#	#	0	1	2	3	4	5	6	7	8	9	12-15
007	000	Y	N	N	N	N	Y	Y	Y	Y	N	5

FIG. 1-4


MOTOROLA
5V / 12V POWER SUPPLIES
CSC
RSC
IRB
RIB 1
RIB 2
RIB 3
TSC
TIB 1
TIB 2
TIB 3
TRUNKED CENTRAL CONTROLLER

21 CHANNEL CENTRAL CONTROLLER

CENTRAL CONTROLLER
20 CHANNEL SYSTEM


CSC
RSC
TSC
IRB
RIB
RIB
RIB
TIB
TIB
TIB

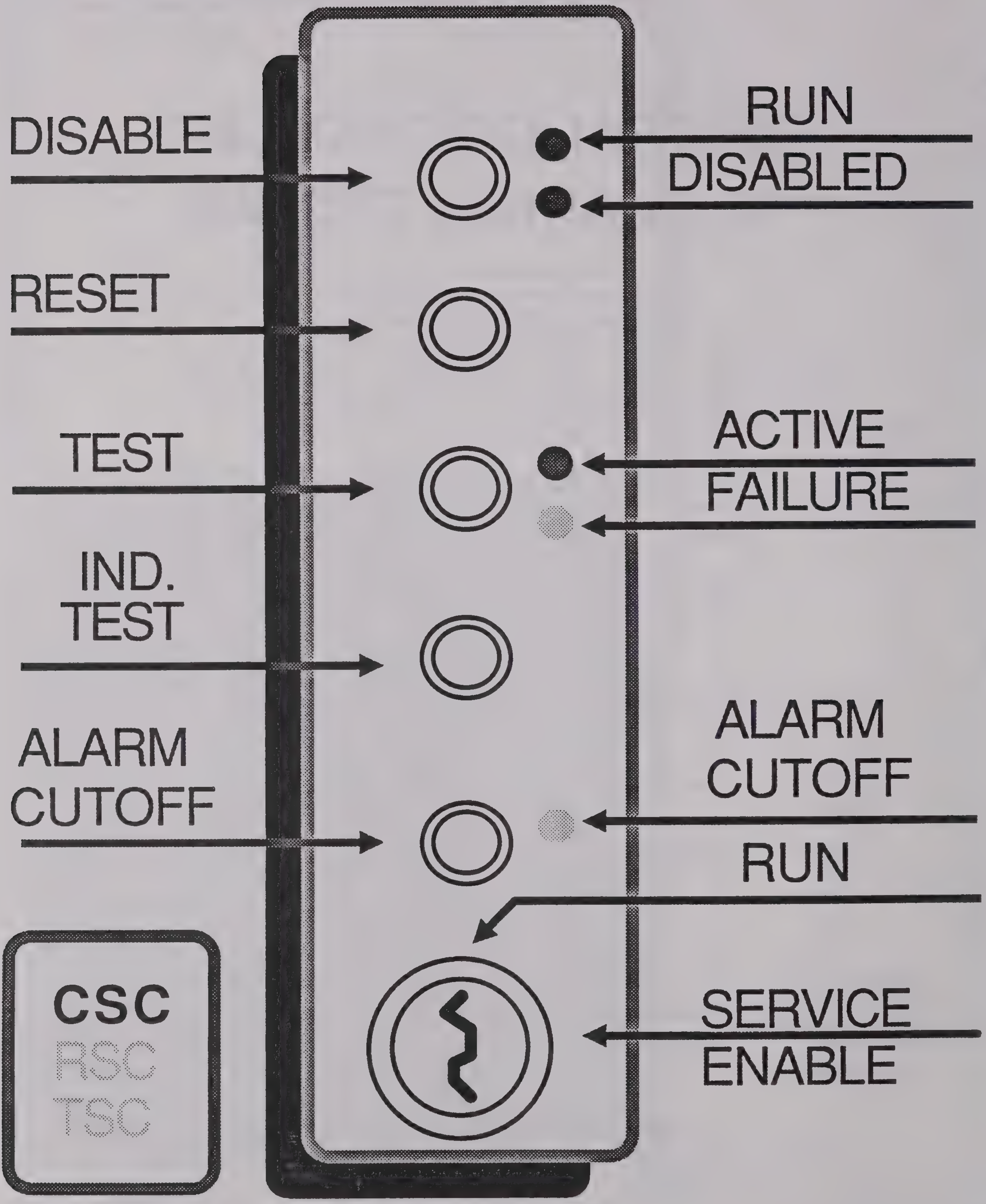
INTERFACES WITH THE FOUR CONTROL CHANNEL REPEATERS

EACH RIB IS CAPABLE OF INTERFACING WITH UP TO 7 REPEATERS

EACH TIB IS CAPABLE OF INTERFACING WITH UP TO 7 REPEATERS

THE IRB, RIB, and TIB INTERFACES WITH THE RESPECTIVE REPEATER'S TRUNK CONTROL MODULE.

Fig. 1.6

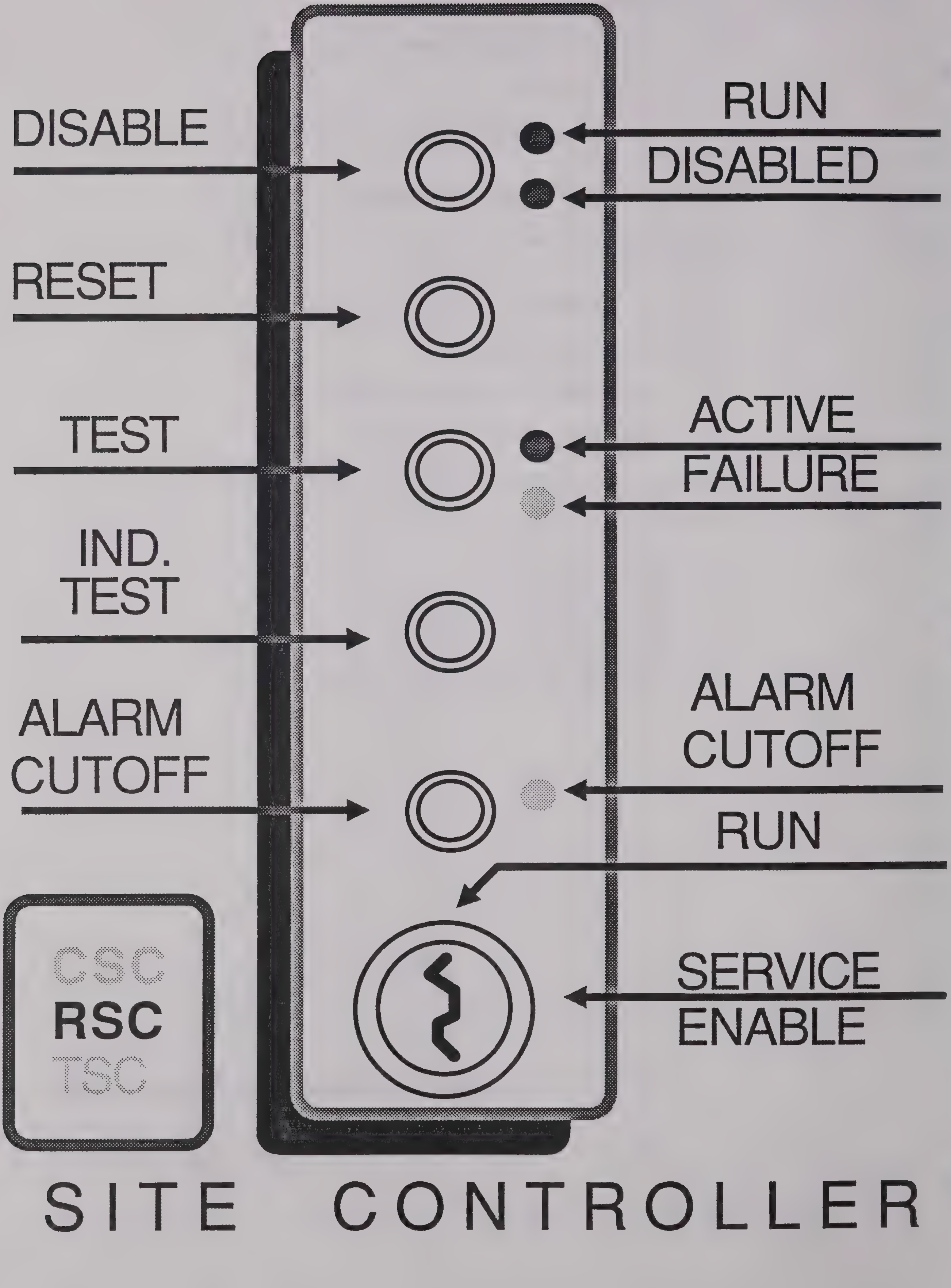

DISABLE
RESET
TEST
IND. TEST
ALARM CUTOFF
RUN
DISABLED
ACTIVE
FAILURE
ALARM CUTOFF
RUN
SERVICE ENABLE
CSC
RSC
TSC

SITE CONTROLLER

XI. FUNCTIONAL DESCRIPTIONS of Boards

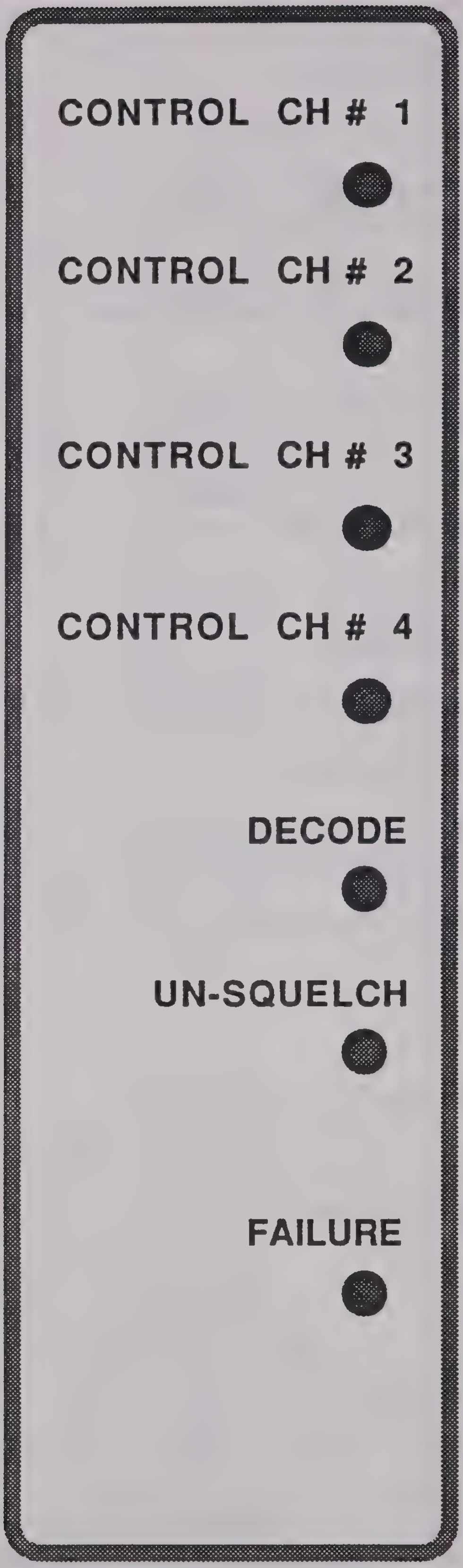
A. CENTRAL SITE CONTROLLER BOARD (CSC)

1. 1 per controller
2. Hardware-wise, identical to other Site Controller Boards.
    a. Uses MC6809 microprocessor
3. Distinguished by the software programmed into each board.
4. The CSC is the heart of the system.
5. Accepts inputs from:
    a. Receiver Site Controller (RSC)
    b. Transmit Site Controller (TSC)
6. Decides on course of action, and tells TSC what to do.
7. Major functions.
    a. Call processing
    b. Call queuing
    c. Resource allocation
    d. Diagnostics
    e. Site to site protocol
    f. Logging of usage statistics.


DISABLE
RESET
TEST
IND. TEST
ALARM CUTOFF
RUN
DISABLED
ACTIVE
FAILURE
ALARM CUTOFF
RUN
SERVICE ENABLE
CSC
RSC
TSC
SITE CONTROLLER

B. RECEIVER SITE CONTROLLER (RSC) BOARD

1. 1 per controller
2. Hardware-wise, identical to other Site Controller Boards.
    a. Uses MC6809 microprocessor
3. Distinguished by the software programmed into each board.
4. The RSC interfaces with:
    a. Inbound Recovery Board (IRB)
    b. Receiver Interface Board (RIB)
    c. Central Site Controller (CSC)
5. Major functions:
    a. Inbound Signaling Word (ISW) recovery
    b. Voice Channel monitoring
    c. Communications protocol with the CSC and other perpheral devices
    d. Site diagnostics


CONTROL CH # 1
CONTROL CH # 2
CONTROL CH # 3
CONTROL CH # 4
DECODE
UN-SQUELCH
FAILURE

INBOUND RECOVERY BOARD

C. INBOUND RECOVERY BOARD (IRB)

1. 1 per controller

2. Interfaces with RSC

3. Works in conjunction with the first four controller channels used as control channels.

   to TCM in base

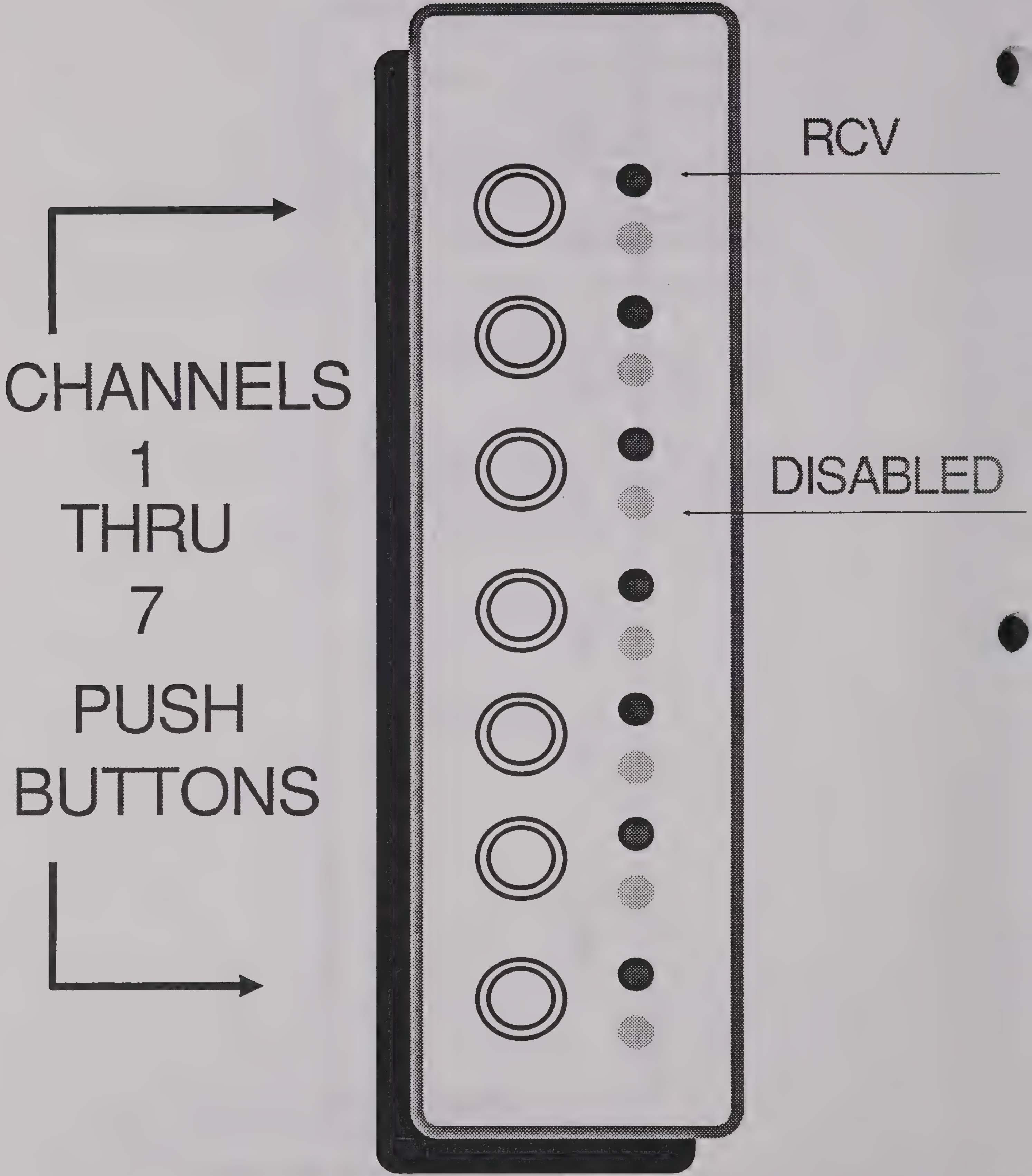
4. Supplies Control Channel Indicator (CCI) to currently assigned control channel.

4. Processes DISC. input (ISW) via three signal processing subsystems:

   1. High speed A/D converter
   2. Bit synchronism recovery circuitry
   3. Memory buffer

78 bit word (ISW) is sent from mobile to the IRB in synchronism with system clock known as the Word Frame Interrupt (WFI) - propagation delay can cause 0-3 bit uncertainty.

84 bits total first 3 proc Delay
sec 3


RCV
CHANNELS
1
THRU
7
PUSH
BUTTONS
DISABLED

RECEIVER INTERFACE BOARD

D. RECEIVER INTERFACE BOARD (RIB)

1. 3 Max. per controller

2. Interfaces with:

    a. 7 repeater station receivers

    b. RSC

3. Receives and processes DISC. input (Trunked Signaling Tones) from each of its repeater station recevers to:

    a. Detect inbound 1800 hz Acknowledge Tone from mobile requesting a voice channel.

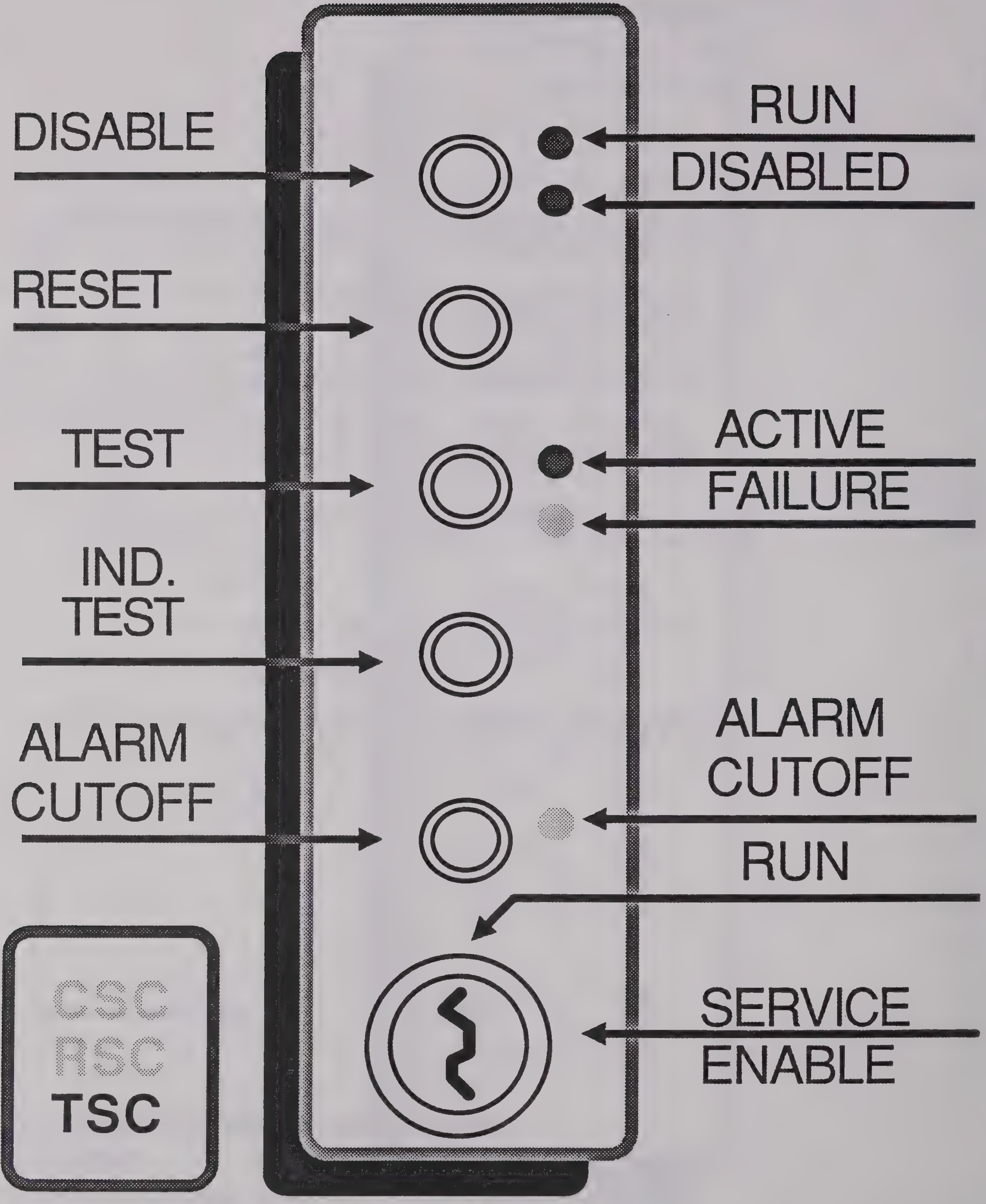
    b. Detect the inbound 105.8 Hz Connect Tone from mobile units transmitting on voice channel.

    c. Detect the inbound 163.6 Hz Disconnect Tone from mobile units leaving the assigned voice channel or upon release of the PTT.

6. Receives the Receiver Status (RSTAT) from repeater station receiver indicating:

	MICOR	MSF-5000
a.	RF Carrier Status	RF Carrier Status
b.	N/A	Tx Synthesizer Lock

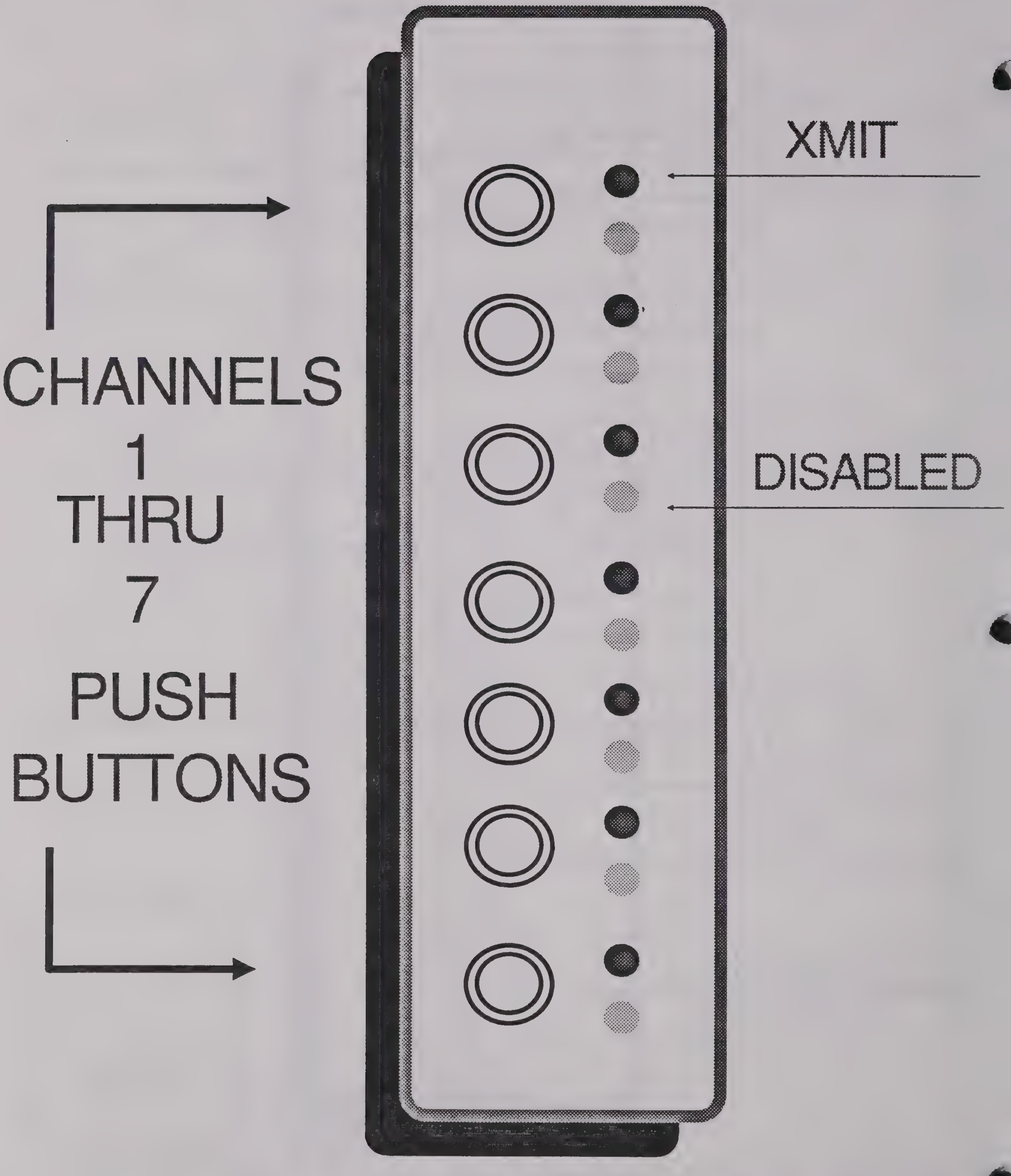
7. Interfaces to the M6809 microprocessor on RSC via two M6821 Peripheral Interface Adapters (PIA's).


DISABLE
RESET
TEST
IND. TEST
ALARM CUTOFF
RUN
DISABLED
ACTIVE
FAILURE
ALARM CUTOFF
RUN
SERVICE ENABLE
CSC
RSC
TSC

SITE CONTROLLER

E. TRANSMITTER SITE CONTROLLER BOARD (TSC)

1. 1 per controller
2. Hardware-wise, identical to other Site Controller Boards.
    a. Uses MC6809 microprocessor
3. Distinguished by the software programmed into each board.
4. The TSC interfaces with:
    a. Transmiter Interface Board (TIB)
    b. Central Site Controller (CSC)
5. Major functions:
    a. The generation of outbound data from the system control channel
    b. Generation of sub-audible data, which is superimposed on all voice channel communications
    c. Base repeater station control
    d. Rf power monitoring
    e. Generation of repeater station identification
    f. Maintenance of communications protocol between other modules and peripheral devices.


XMIT
CHANNELS
1
THRU
7
PUSH
BUTTONS
DISABLED

TRANSMITTER INTERFACE BOARD

F. TRANSMITTER INTERFACE BOARD (TIB)

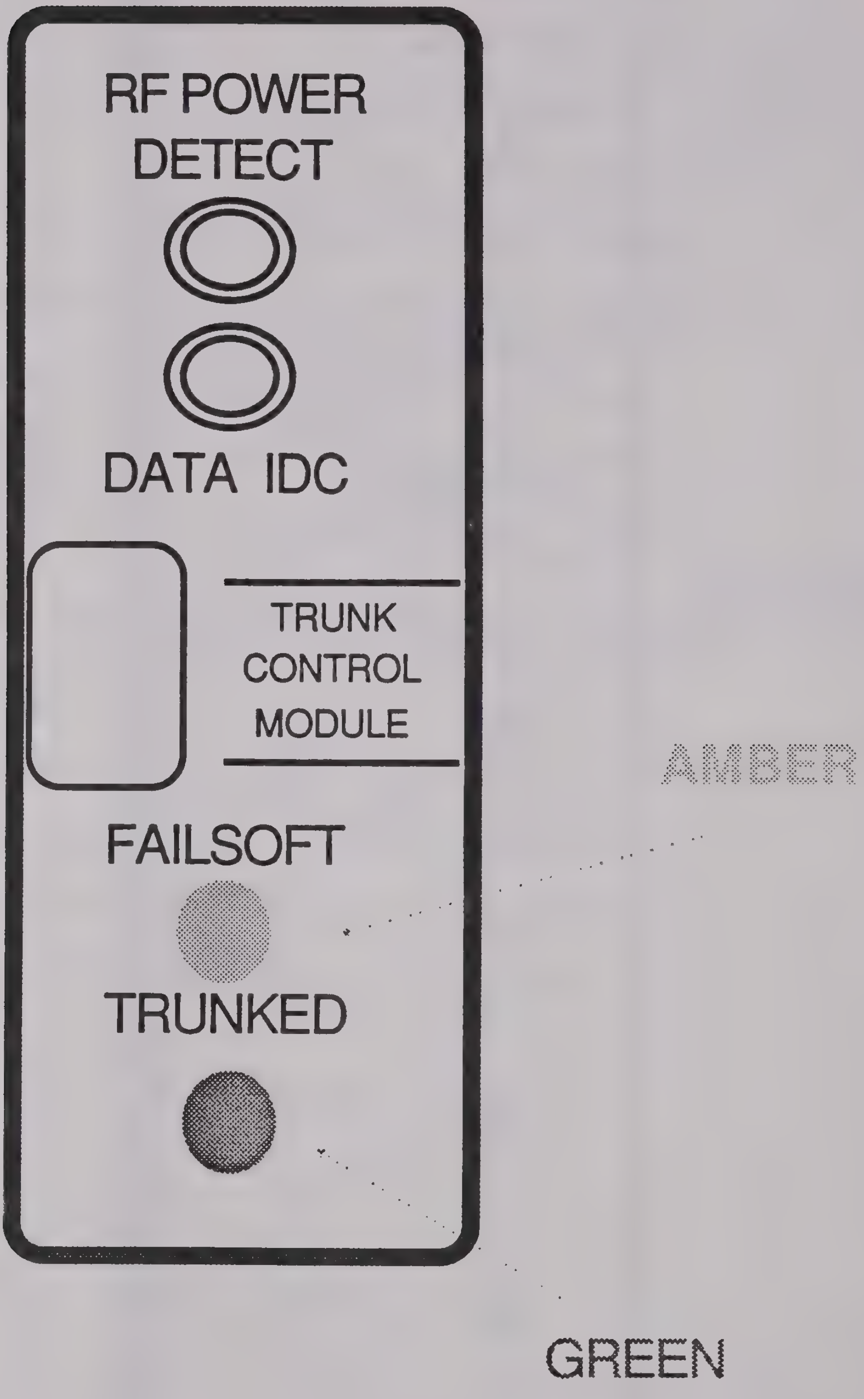
1. 3 Max. per controller
2. Interfaces with:
   - a. 7 repeater station transmitters
   - b. TSC
3. Receives MPU address and data bus signals from the TSC
4. Produces data and control signals for each of its repeater station transmitters

   fast fail soft continuous data
   - a. TDATA - OSW, HSHS, LSHS, DISCONNECT WORD
   - b. PTT - Transmitter keying $\overline{\text{MUTE}}$

   control ch or tel interconnect
   - c. MUTE with TICKLE - In Cabinet Repeat / Failsoft Timer control

   for slow
5. Receives Transmitter Status (TSTAT) from repeater station transmitter(s) indicating:

	MICOR	MSF-5000
a.	Forward Power	Forward Power
b.	Reflected Power	Reflected Power
c.	Keyed A+	Transmitter Activity
d.	N/A	Synthesizer Lock


RF POWER
DETECT
DATA IDC
TRUNK
CONTROL
MODULE
AMBER
FAILSOFT
TRUNKED
GREEN

TRUNK CONTROL
MODULE
(MICOR)

G. TRUNK CONTROL MODULE (TCM)

1. General

a. The TCM interfaces the Central Controller with a 35 Watt, 70 Watt, or 125 Watt MICOR Trunked Base-Repeater station.

b. The TCM has two modes of operation:

1).Trunked Mode
2).Failsoft Mode

2. FRONT PANEL INDICATORS

a). Green light indicates normal trunking mode of operation.

b). Yellow light indicates repeater in failsoft mode of operation.

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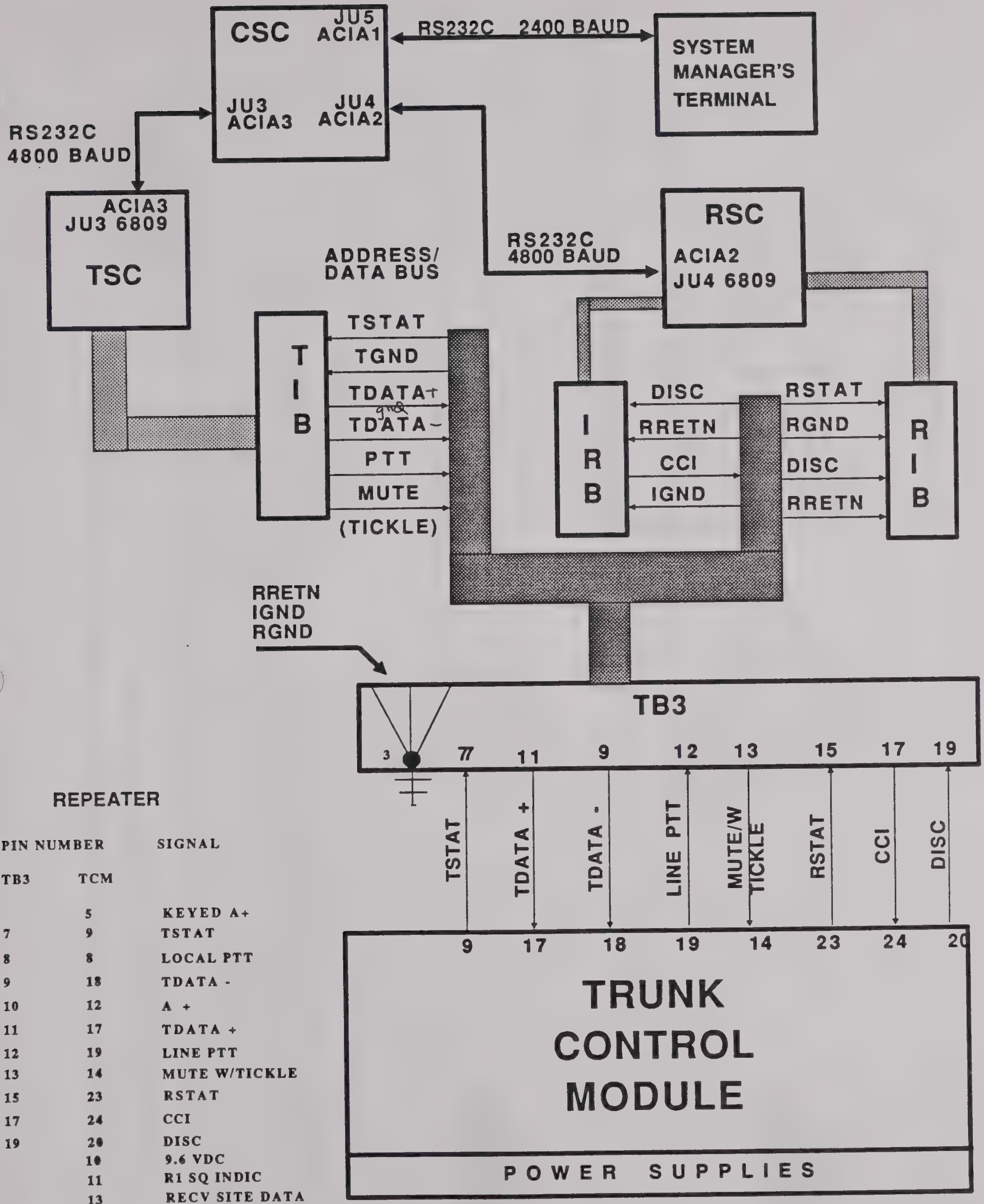
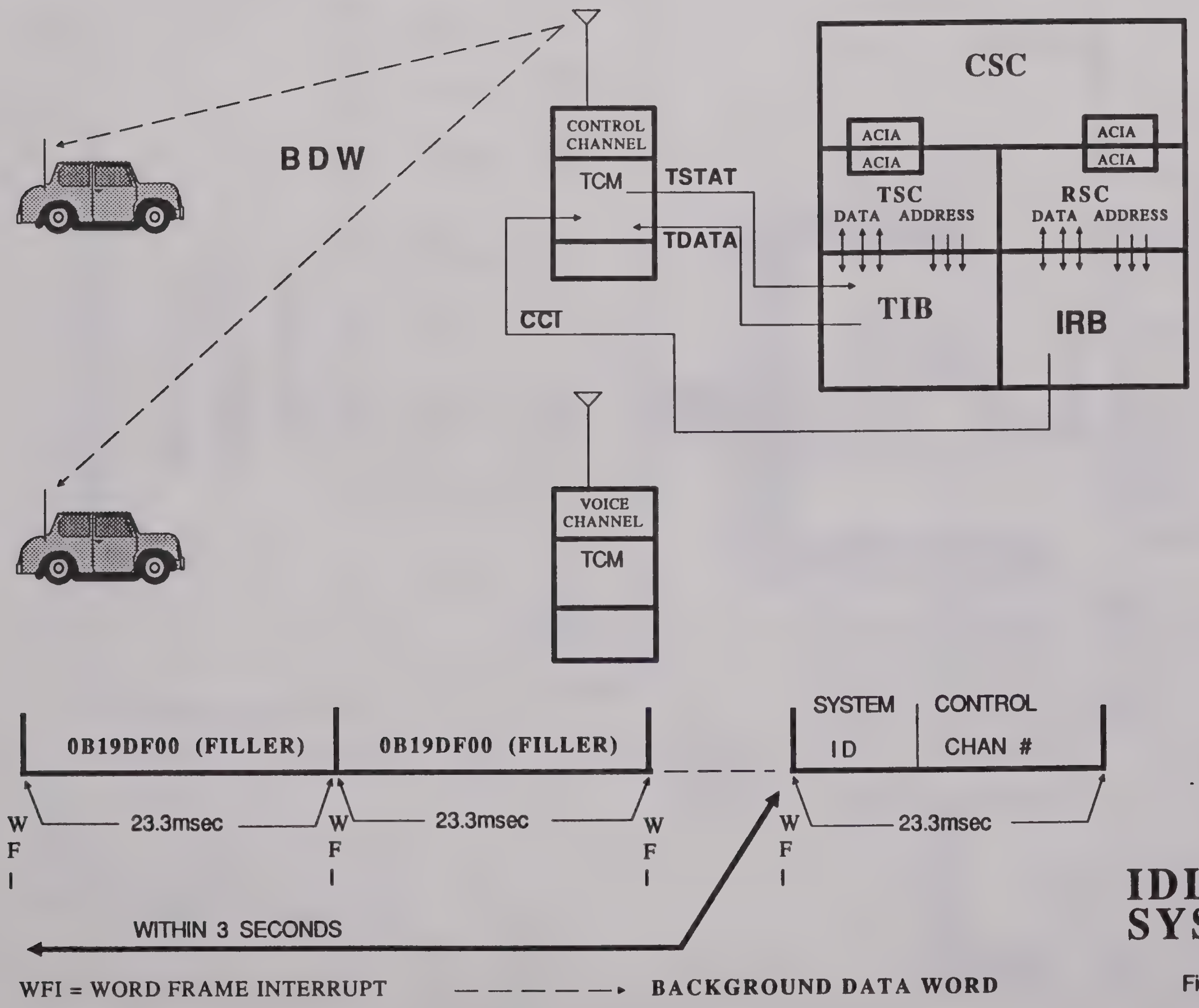

CSC
JU5
ACIA1
JU3
ACIA3
JU4
ACIA2
RS232C 2400 BAUD
SYSTEM MANAGER'S TERMINAL
RS232C
4800 BAUD
ACIA3
JU3 6809
TSC
ADDRESS/
DATA BUS
RS232C
4800 BAUD
RSC
ACIA2
JU4 6809
TIB
TSTAT
TGND
TDATA+
gnd
TDATA-
PTT
MUTE
(TICKLE)
IRB
DISC
RRETN
CCI
IGND
RSTAT
RGND
DISC
RRETN
RIB
RRETN
IGND
RGND
TB3
3
77
11
9
12
13
15
17
19
TSTAT
TDATA +
TDATA -
LINE PTT
MUTE/W TICKLE
RSTAT
CCI
DISC
9
17
18
19
14
23
24
20
TRUNK CONTROL MODULE
POWER SUPPLIES

REPEATER

PIN NUMBER TB3	TCM	SIGNAL
	5	KEYED A+
7	9	TSTAT
8	8	LOCAL PTT
9	18	TDATA -
10	12	A +
11	17	TDATA +
12	19	LINE PTT
13	14	MUTE W/TICKLE
15	23	RSTAT
17	24	CCI
19	20	DISC
	10	9.6 VDC
	11	R1 SQ INDIC
	13	RECV SITE DATA
	15	AUDIO MUTE

Fig. 1.7


BDW
CONTROL CHANNEL
TCM
TSTAT
TDATA
CCI
VOICE CHANNEL
TCM
CSC
ACIA
ACIA
ACIA
ACIA
TSC
DATA ADDRESS
RSC
DATA ADDRESS
TIB
IRB
0B19DF00 (FILLER)
0B19DF00 (FILLER)
SYSTEM ID
CONTROL CHAN #
23.3msec
23.3msec
23.3msec
WFI
WFI
WFI
WFI
WITHIN 3 SECONDS
WFI = WORD FRAME INTERRUPT
BACKGROUND DATA WORD

IDLE SYSTEM

Fig. 1.1.1.

XII. TRUNKED SYSTEM SIGNALLING (TYPE I)

A. IDLE SYSTEM (fixed end)

1. The designated Central Site Controller transmits a Background Data Word (OSW) via the control channel.

    a. Used for bit and word synchronization.

    b. System ID (OSW) that is sent at least every 3 seconds.

2. **Mobile Powers Up**

    a. Scans for control channel

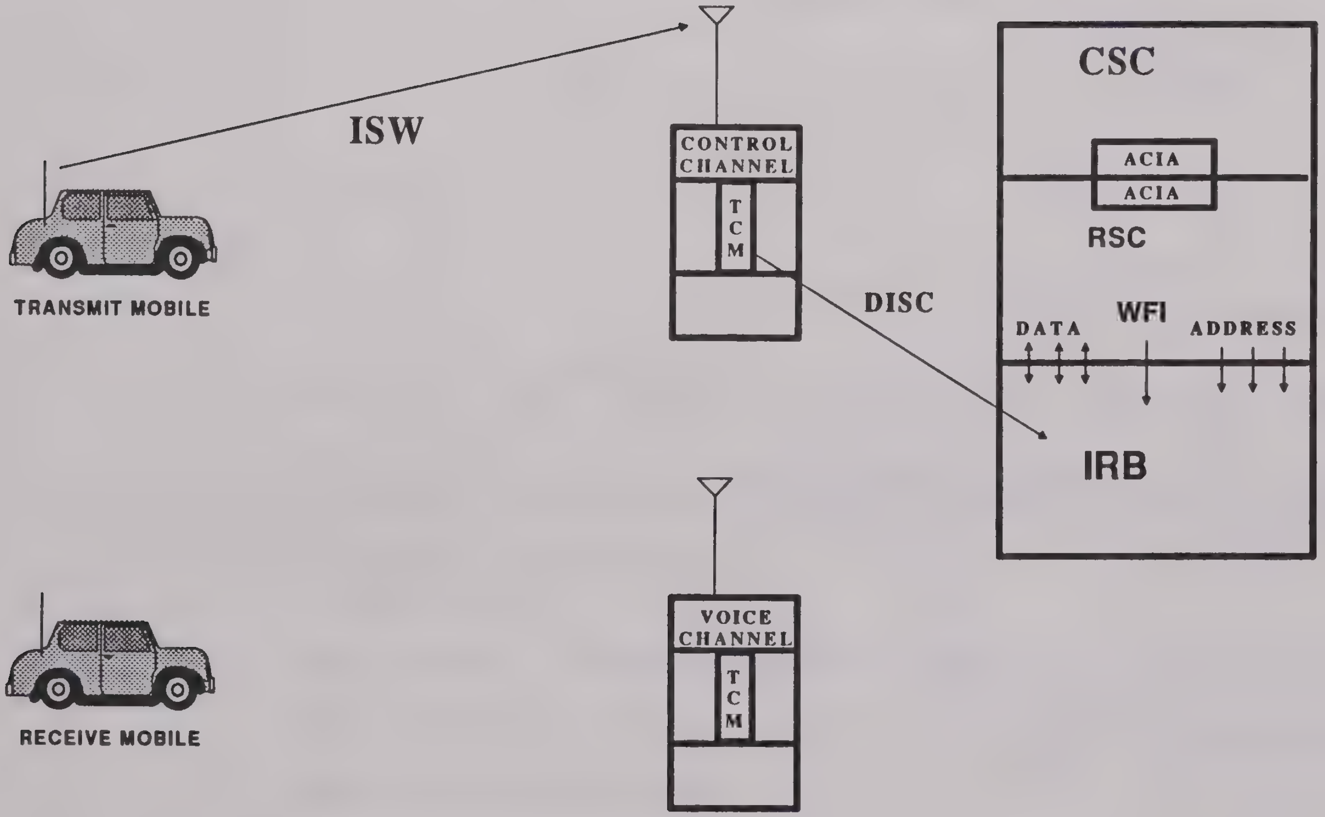
    b. When System ID is found, the unit will monitor background data word.

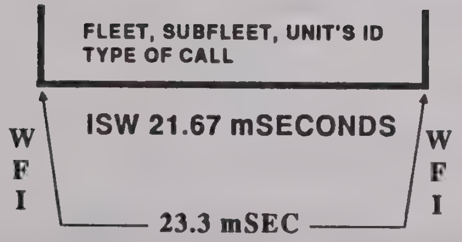
    c. Once locked on control channel, mobile decodes the OSW's.

        1). System ID.
        2). Control channel data.

    d. If system ID and control channel frequency does not match mobile code plug information, the unit will continue to scan.

    e. Mic PTT - mobile polls PTT synchronized to the word frame (23.3 mSecs) to see if it has been depressed.


ISW
CSC
CONTROL CHANNEL
TCM
ACIA
ACIA
RSC
TRANSMIT MOBILE
DISC
DATA
WFI
ADDRESS
IRB
VOICE CHANNEL
TCM
RECEIVE MOBILE


FLEET, SUBFLEET, UNIT'S ID
TYPE OF CALL
ISW 21.67 mSECONDS
WFI
WFI
23.3 mSEC

VOICE CHANNEL REQUEST

Fig. 1.1.2

B. VOICE CHANNEL REQUEST

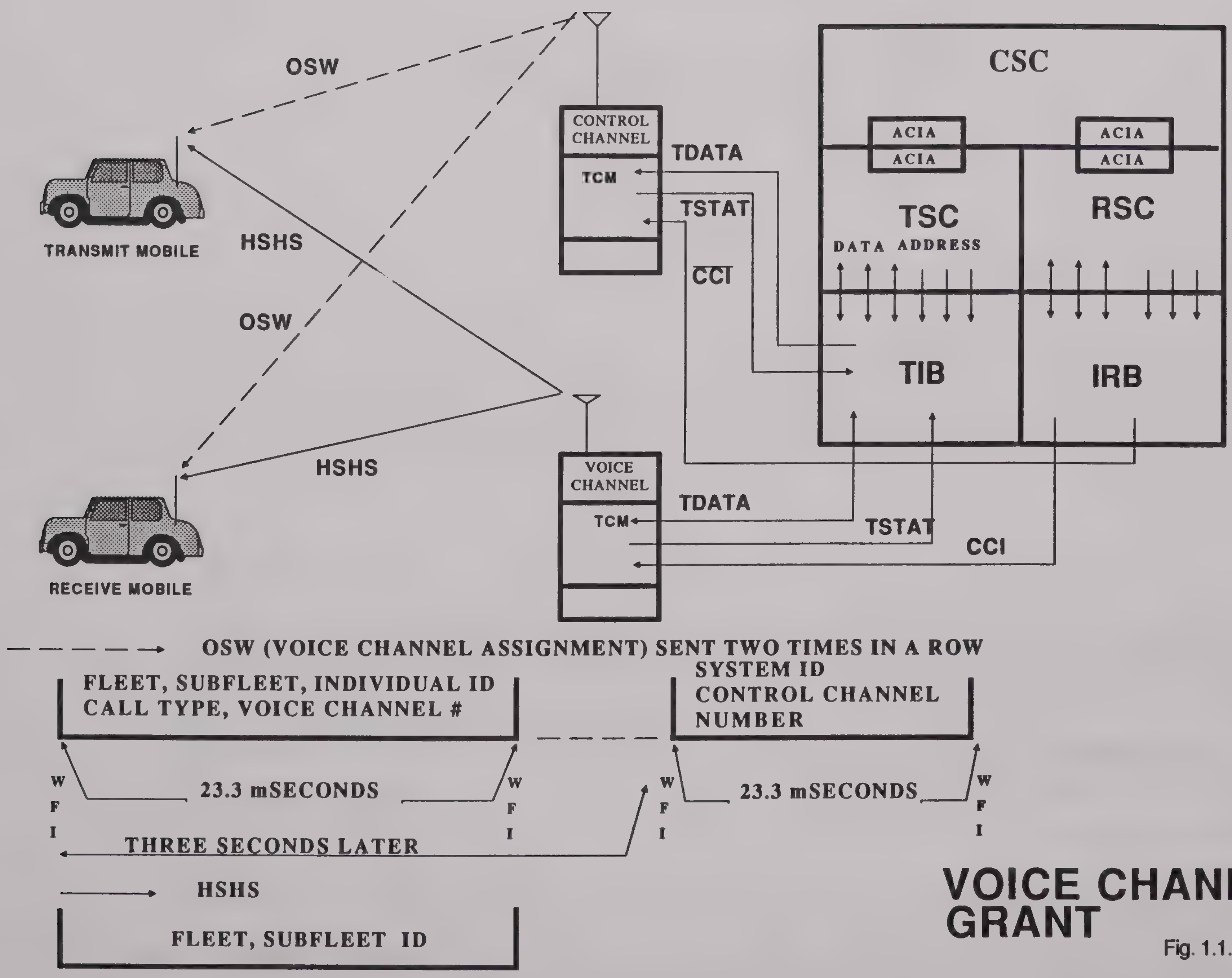
1. When PTT is depressed, the mobile sends an Inbound Signaling Word (ISW) to request a voice channel.

2. ISW - 78 bit word sent in 21.67 mSec at 3600 baud (21 information bits polled from code plug).

3. ISW contains (1) prefix, (2) fleet ID (3) subfleet ID (4) individual ID (5) type call - group, system, individual.

4. When the ISW, or request for service, is received thru the TCM and sent to and decoded by the Inbound Recovery Board (IRB) with the Receiver Site Controller (RSC). The Central Site Controller (CSC) is then informed of the channel request.

5. Inserted in queue by Central Controller.


OSW
HSHS
OSW
HSHS
TRANSMIT MOBILE
RECEIVE MOBILE
CONTROL CHANNEL
TCM
TDATA
TSTAT
CCI
VOICE CHANNEL
TCM
TDATA
TSTAT
CCI
CSC
ACIA
ACIA
ACIA
ACIA
TSC
DATA ADDRESS
RSC
TIB
IRB
OSW (VOICE CHANNEL ASSIGNMENT) SENT TWO TIMES IN A ROW
FLEET, SUBFLEET, INDIVIDUAL ID
CALL TYPE, VOICE CHANNEL #
SYSTEM ID
CONTROL CHANNEL NUMBER
WFI
23.3 mSECONDS
WFI
WFI
23.3 mSECONDS
WFI
THREE SECONDS LATER
HSHS
FLEET, SUBFLEET ID

VOICE CHANNEL GRANT

Fig. 1.1.3

C. Channel Grant Outbound Signaling Word

1. The CSC checks all voice channels for activity status. The CSC instructs the Transmitter Site Controller (TSC) to send an Outbound Signal Word (OSW) via the Transmitter Interface Board (TIB) to the designated Control Channel TCM and transmitted to the initiating mobile twice in rapid succession.

2. The OSW contains the following information:

   a. Fleet ID.
   b. Subfleet ID.
   c. Individual ID.
   d. Type of call.
   e. Voice channel assignment
   f. Busy, if no channel available, a busy will be transmitted.

3. If channel was granted, OSW will be repeated randomly during radio conversation to update new mobiles. (Continuous assignment updating.)

Channel Available

1. Initiating mobile receives OSW on designated control channel.

2. Switches to assigned voice channel (for group calls - all other radios in the same fleet or subfleet move to the directed voice channel).

3. When a channel grant is issued, the CSC instructs the TSC to simultaneously generate an OSW on the control channel and a High Speed Handshake (HSHS) Data Word on the assigned voice channel. This TSC Data is sent via the TIB to the control channel TCM for transmission.

HSHS

1. HSHS identifies (1) fleet, subfleet ID.

2. HSHS - 21 bit word at 3600 baud for 6 mSec (sent for a total of 96 mSec or until an Acknowledge Tone is received from the mobile/portable) for fleet or subfleet ID corresponding to requestor.

3. **Transmitting Mobile**

    a. The requesting mobile receives the OSW on the designated Control Channel and then:

        1). Switches to its assigned voice channel or causes a busy light/tone if all voice channels are busy.

        2). The receiving mobiles within the fleet, subfleet are switched to the assigned voice channel.

    b. The requesting mobile verifies the HSHS on the assigned voice channel.

    c. If HSHS is not detected after 96 mSeconds, requesting mobile transmitter is not enabled on the voice channel and mobile returns to control channel.

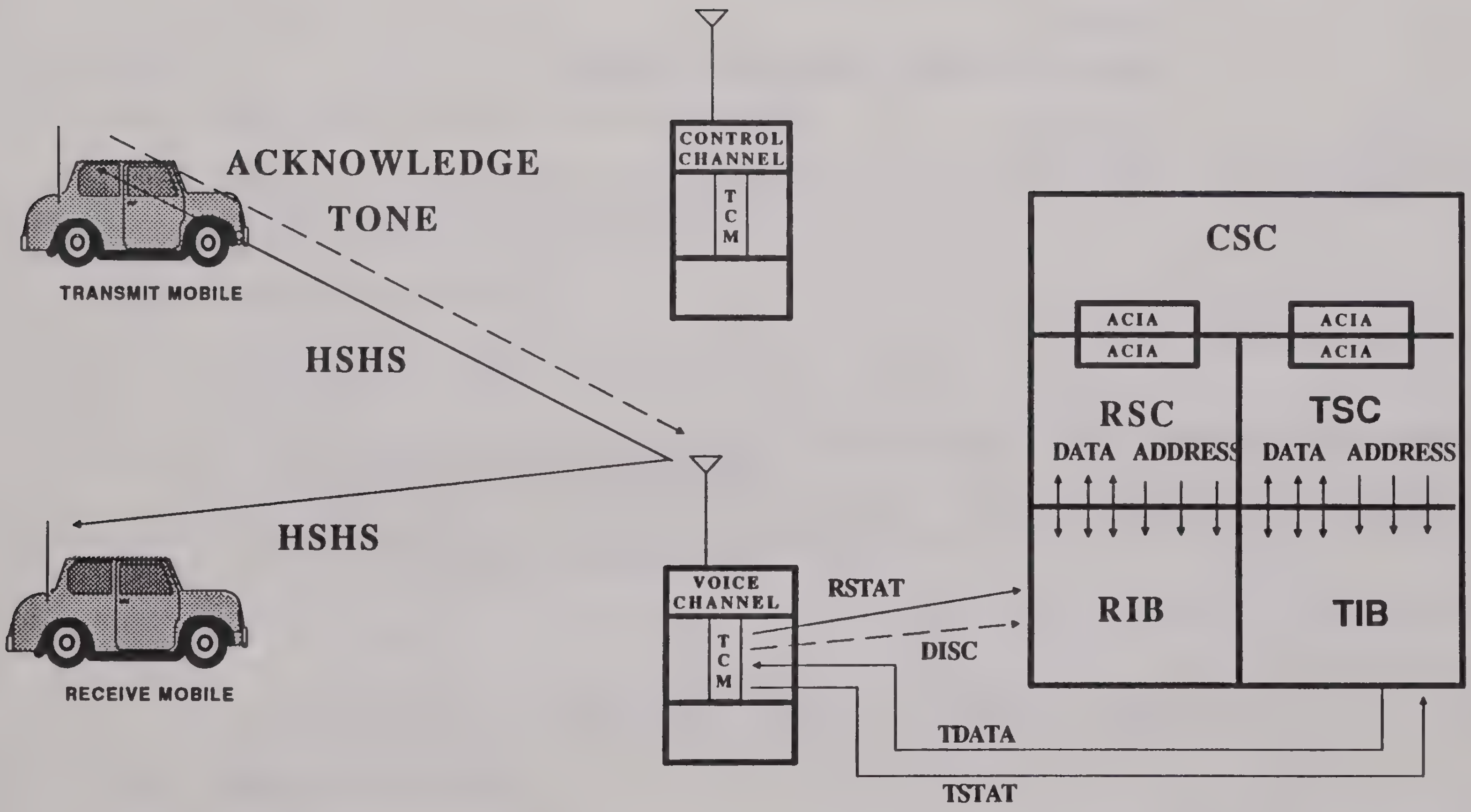
4. **Receiving Mobiles**

    a. When the receiving mobile switches to the voice channel and accomplishes the following:

        1). Used to verify mobile is on proper voice channel after receipt of channel assignment OSW.

2). Once detected, speeds un-muting (enables low speed mode) of receive audio.

3). If HSHS not detected after 16 HSHS Data Words, mobile automatically enters low speed mode and tries to detect LSHS.


ACKNOWLEDGE
TONE
TRANSMIT MOBILE
HSHS
HSHS
RECEIVE MOBILE
CONTROL CHANNEL
TCM
VOICE CHANNEL
TCM
RSTAT
DISC
TDATA
TSTAT
CSC
ACIA
ACIA
ACIA
ACIA
RSC
DATA ADDRESS
TSC
DATA ADDRESS
RIB
TIB

ACKNOWLEDGE TONE

——→ HIGH SPEED HANDSHAKE (HSHS)

– – – → ACKNOWLEDGE TONE
(1800 Hz 80 mSECONDS)

Fig. 1.1.4

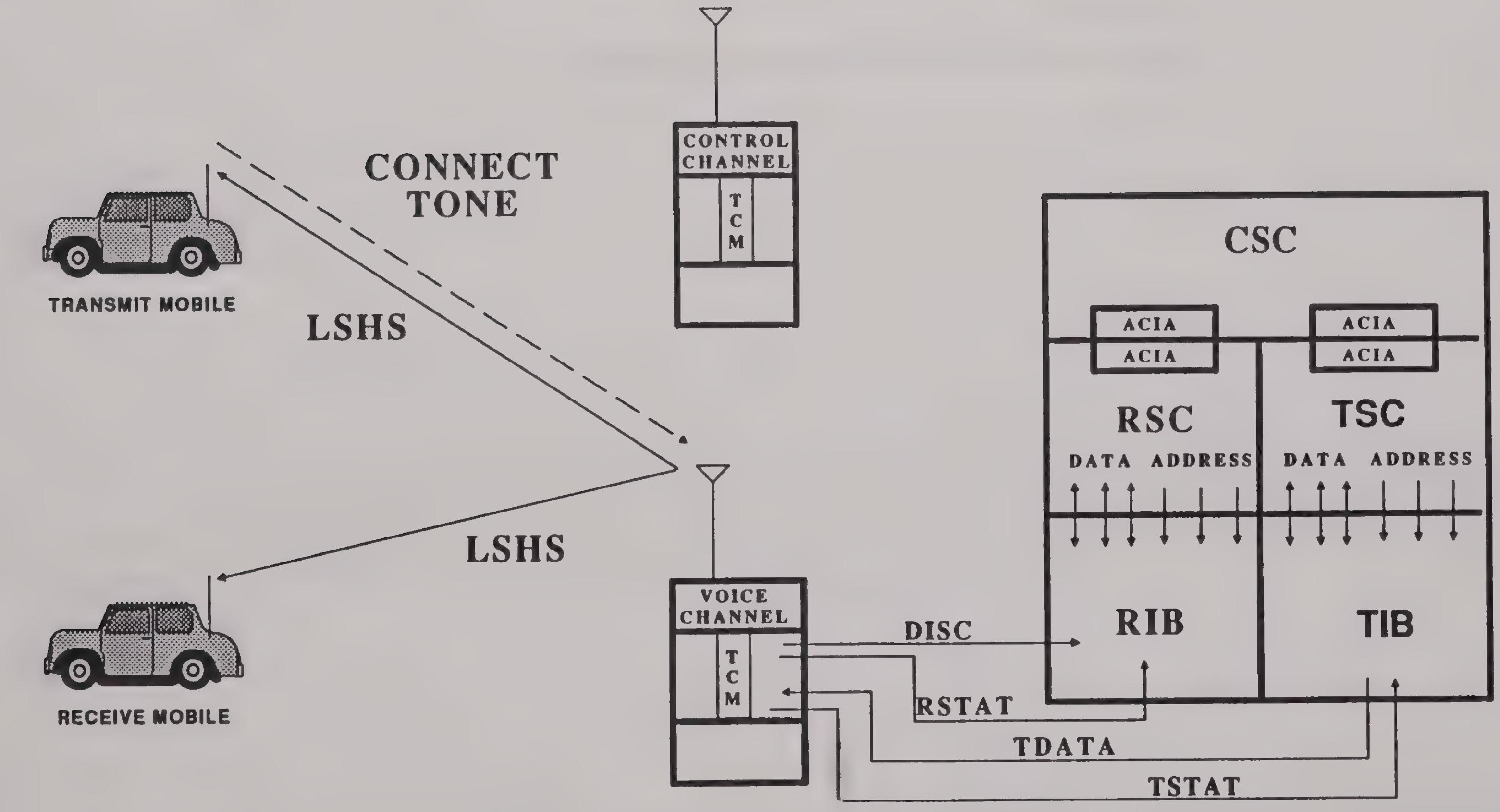
D. Acknowledge Tone

1. Upon verification of the HSHS, transmitting mobile keys up and sends a High Speed Acknowledge Tone.

   a. 1800 Hz for 80 mSec. duration.

   b. Informs the CSC via the TCM, the RIB, and RSC that the mobile has switched to the proper voice channel.

   c. The CSC recognizes the HS Acknowledge Tone and stops sending the HSHS.


TRANSMIT MOBILE
CONNECT TONE
LSHS
CONTROL CHANNEL
TCM
CSC
ACIA
ACIA
ACIA
ACIA
RSC
TSC
DATA ADDRESS
DATA ADDRESS
LSHS
RECEIVE MOBILE
VOICE CHANNEL
TCM
DISC
RIB
TIB
RSTAT
TDATA
TSTAT

CONNECT TONE

——————→ LOW SPEED HANDSHAKE (LSHS)

- - - - - - → CONNECT TONE
(105.88 Hz or SP)

Fig. 1.1.5

E. Connect Tone

1. The initiating mobile then sends a subaudible Connect Tone on the voice channel while PTT is maintained during the voice message period.

2. The CSC receives the Connect Tone via the TCM, the RIB and the RSC allowing the mobile to maintain the assigned voice channel.

   a. Upon reception and decoding of the Connect Tone, the CSC instructs TIB via the TSC to send the appropriate signals to unmute the assigned voice channel.

   b. Mobile microphone is un-muted and voice transmission begins.

3. Mobile transmits the sub-audible Connect Tone at low deviation.

   0

4. Standard Connect Tone is 105.88 Hz with other frequency options available. (i.e. 76.7 Hz, 83.7 Hz, 90.0 Hz, 97.3 Hz, 128.5 Hz, 138.46 Hz.)

   1 2 3 4 5 6

LOW SPEED HANDSHAKE (LSHS) OR Connect Word

RECEIVING MOBILE

1. When the HSHS ceases, the CSC instructs the TSC via the TIB and respective TCM to send the Low Speed Handshake Data (LSHS) or Connect Word continuously on the assigned Voice Channel.

   a. LSHS data:

      1) Slower speed: 150 Baud.
      2). Lower deviation.
      3). Fleet ID.
      4). Subfleet ID.

2. Used to unmute received audio and to hold receiving radios on assigned voice channel. To stay on voice channel, must continue to detect LSHS data.

LSHS

P	F	S

First 21 bits of OSW (@150 baud) sent from central.

3. Receive radio will unmute after receiving one sync portion (first eight bits) of LSHS.

4. If no HSHS was detected, two entire low speed in a row must be detected to unmute receive audio.

5. To stay on voice channel, must continue to detect LSHS data words.

6. If not detected, radio will return to control channel.

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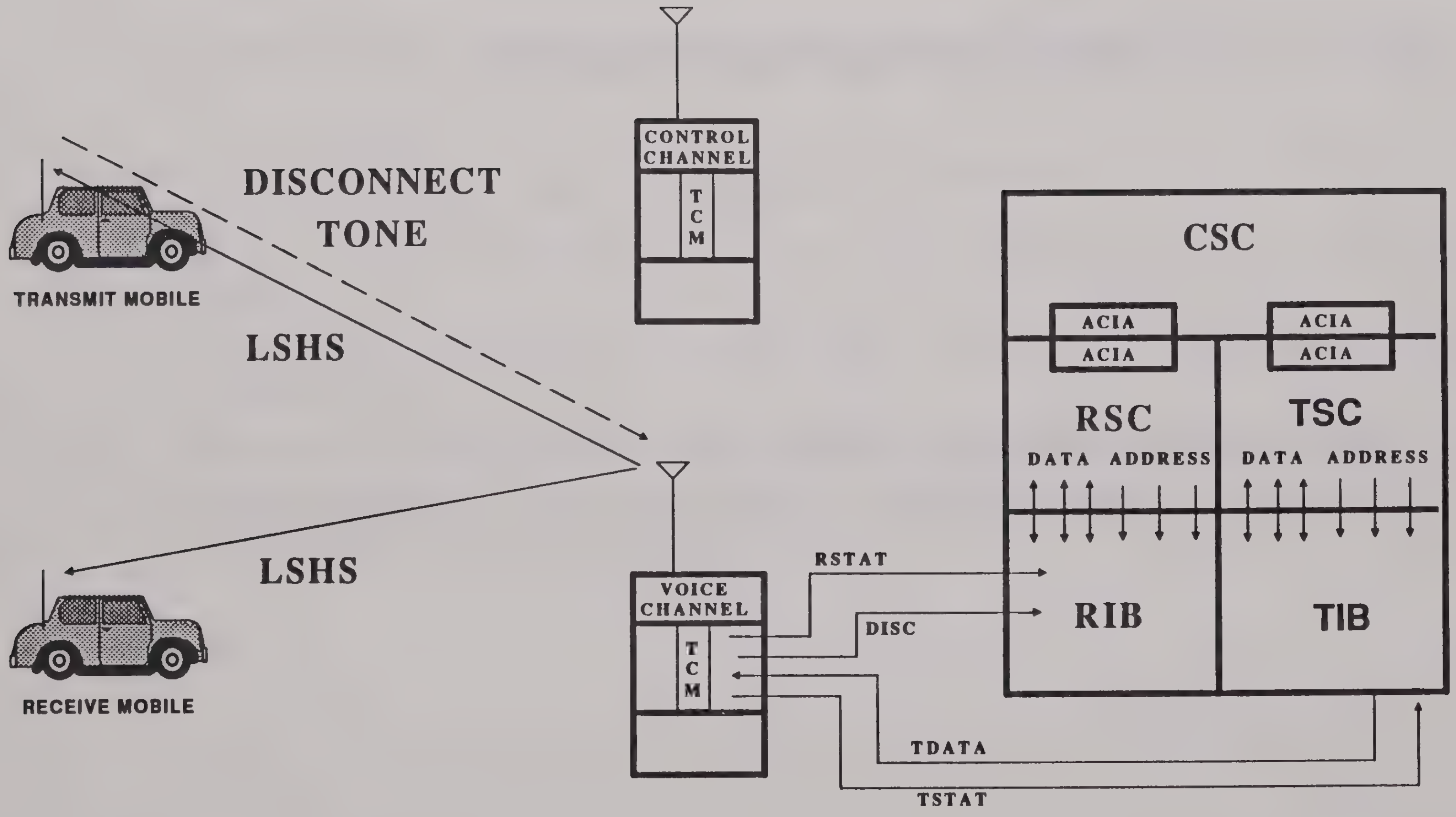


DISCONNECT
TONE
TRANSMIT MOBILE
LSHS
LSHS
RECEIVE MOBILE
CONTROL CHANNEL
T C M
VOICE CHANNEL
T C M
CSC
ACIA
ACIA
ACIA
ACIA
RSC
TSC
DATA ADDRESS
DATA ADDRESS
RSTAT
DISC
RIB
TIB
TDATA
TSTAT

DISCONNECT TONE

——→ LOW SPEED HANDSHAKE (LSHS)

- - - → DISCONNECT TONE
(163.64 Hz, 200 mSECONDS)

Fig. 1.1.6

F. DISCONNECT TONE

1. Release of PTT causes the mobile to sends a 200 mSec, 163.64 Hz., Disconnect Tone.

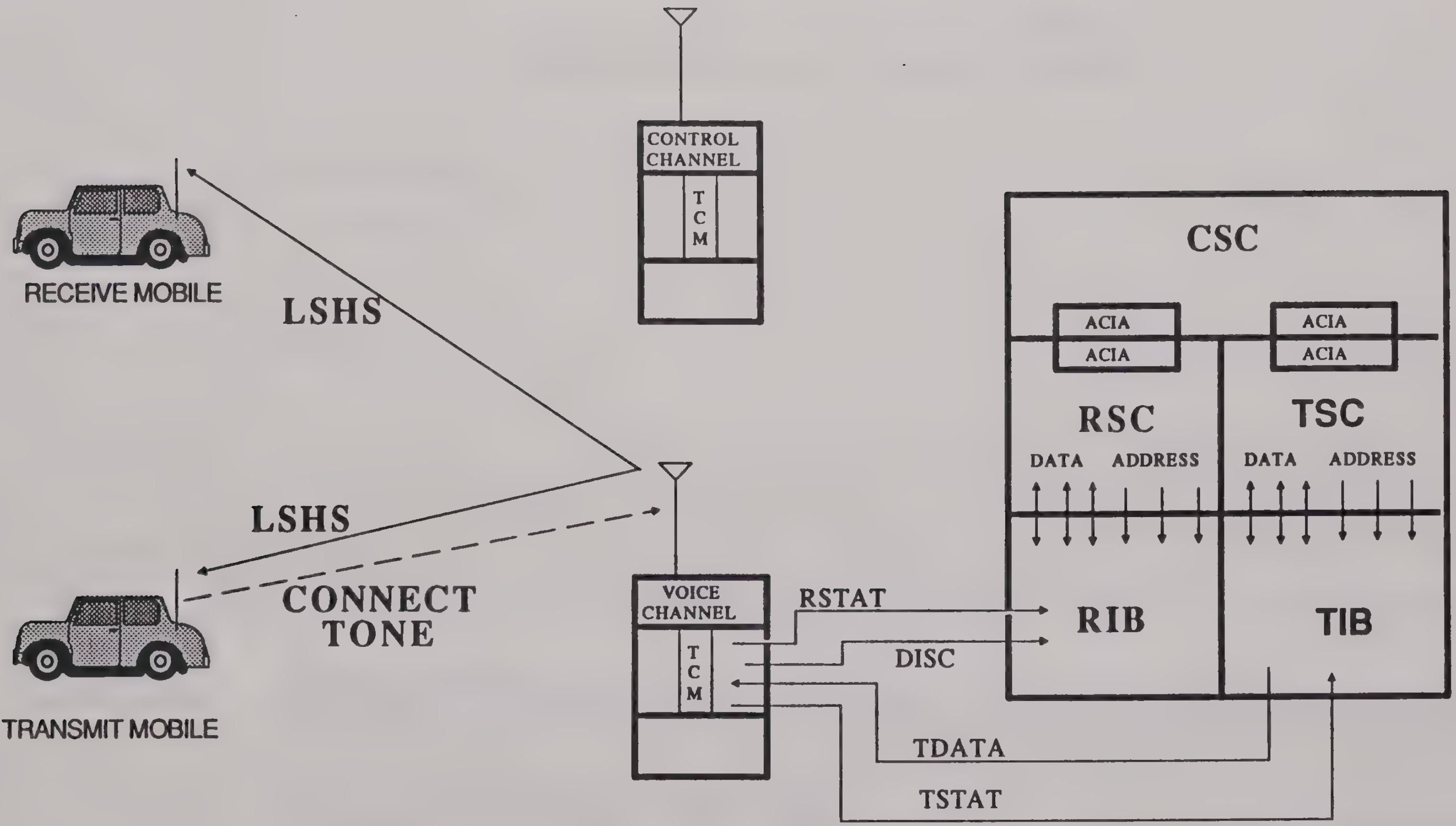
2. The Disconnect Tone is recognized by the CSC via the TCM, RIB, and RSC starting the message Time Out Timer (TOT) located in the TSC (Hang Time).

   a. Programmable from 0 to 6.3 seconds.

   b. In message trunking, the Central Controller detects the Disconnect Tone and begins a message time-out timer.

   c. In transmission trunking, the Central Controller detects the Disconnect Tone and immediately sends the Disconnect Word sending all concerned radios to the Control Channel.

3. The requesting mobile switches to receive mode and unmutes its speaker after detecting LSHS.


CONTROL CHANNEL
TCM
RECEIVE MOBILE
LSHS
CSC
ACIA
ACIA
ACIA
ACIA
RSC
TSC
DATA
ADDRESS
DATA
ADDRESS
LSHS
CONNECT TONE
TRANSMIT MOBILE
VOICE CHANNEL
TCM
RSTAT
DISC
RIB
TIB
TDATA
TSTAT

CALL CONTINUATION

——→ LOW SPEED HANDSHAKE (LSHS)

- - - - - -→ CONNECT TONE
(105.88 Hz or SP)

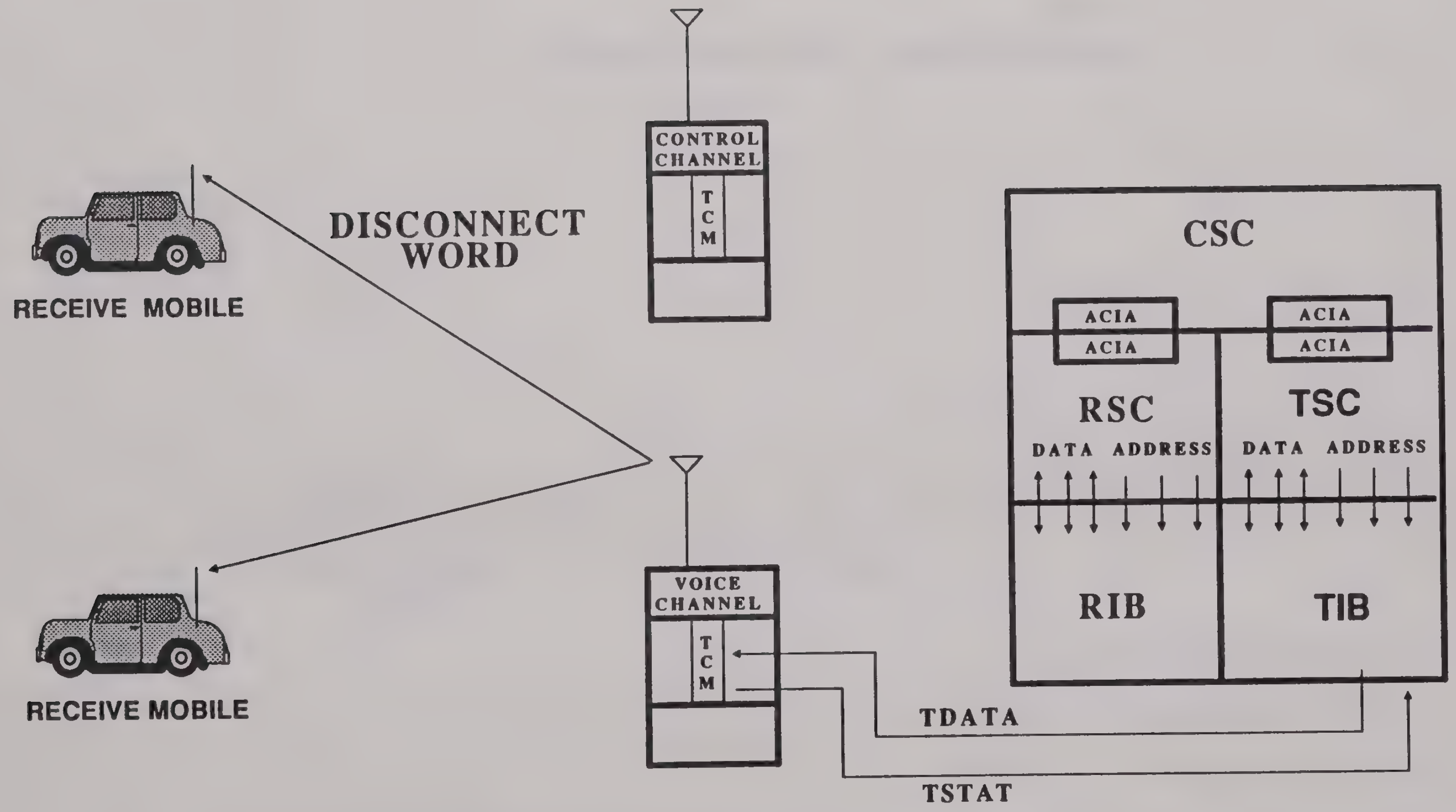
Fig. 1.1.7

G. Call Continuation

1. Any other receiving radio on the same voice channel may respond to the original transmitting radio by pressing PTT and sending a Connect Tone plus voice to maintain the same voice channel. (Message Trunking)

   a. System/Fleet calls are transmission trunked.

2. The CSC recognizes the responding mobile's Connect Tone, instructs the TSC to reset the message Time Out Timer.


CONTROL CHANNEL
TCM
DISCONNECT WORD
RECEIVE MOBILE
RECEIVE MOBILE
VOICE CHANNEL
TCM
CSC
ACIA
ACIA
ACIA
ACIA
RSC
TSC
DATA ADDRESS
DATA ADDRESS
RIB
TIB
TDATA
TSTAT

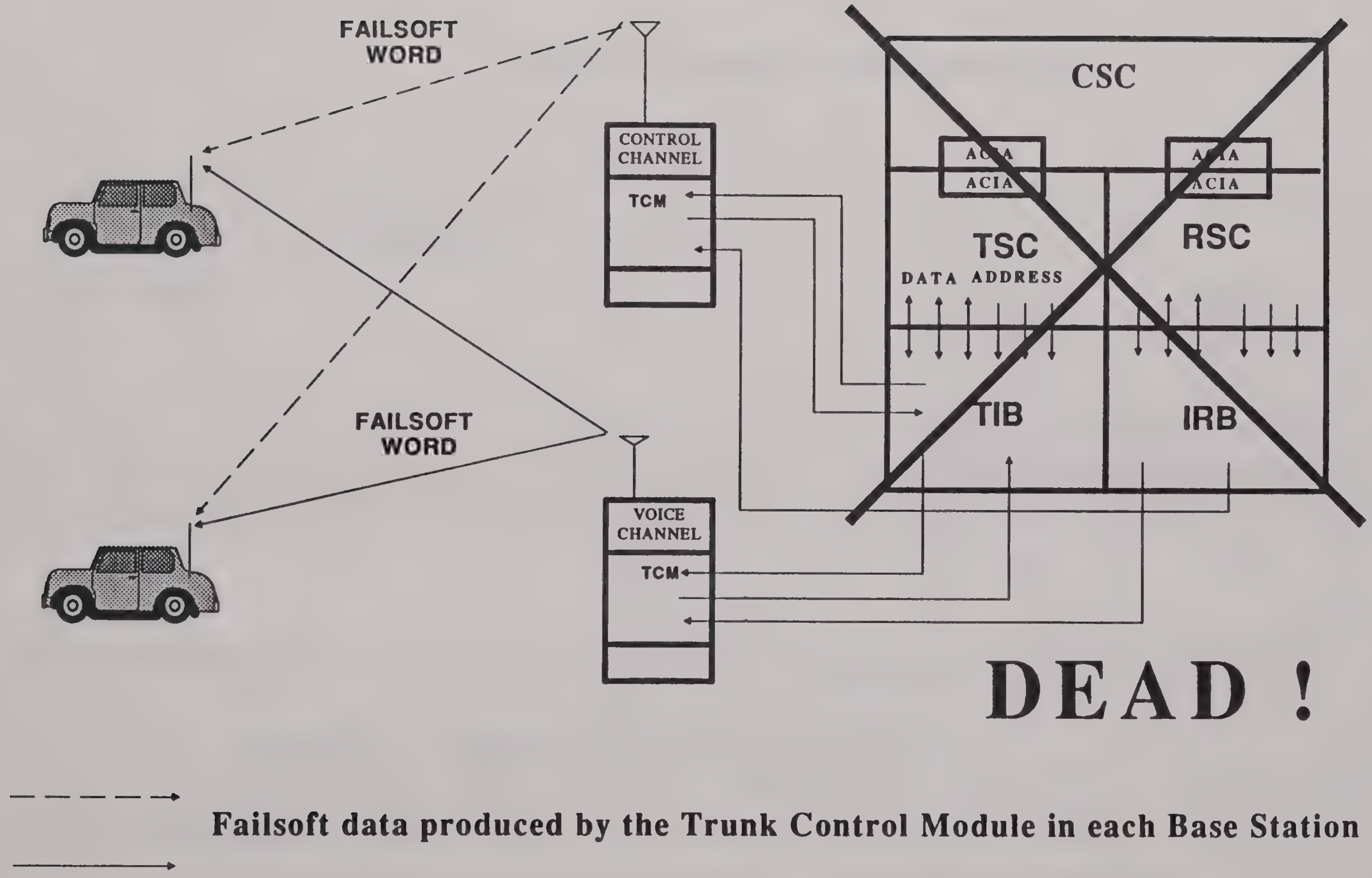
DISCONNECT WORD

→ DISCONNECT WORD
(125 mSECONDS, 300 BAUD)

Fig. 1.1.8

H. Disconnect Word

1. The CSC instructs the TSC via the TIB and TCM to send the Disconnect Word.
    - a. 125 mSec duration.
    - b. 300 Baud at 1 KHz deviation.
2. The receiving mobiles mute and return to control channel.
3. After the Low Speed Disconnect Word ceases on the voice channel, the CSC may now reassign the channel to another call.


FAILSOFT WORD
CONTROL CHANNEL
TCM
CSC
ACIA
ACIA
ACIA
ACIA
TSC
RSC
DATA ADDRESS
TIB
IRB
FAILSOFT WORD
VOICE CHANNEL
TCM
DEAD !

Failsoft data produced by the Trunk Control Module in each Base Station

Failsoft

Fig. 1.1.9

I. Failsoft

1. During normal system operation, the central controller toggles the base station required to keep the base station in the trunking mode.

2. When toggling stops (CC failure), base stations revert to the failsoft mode.

3. Base station unmutes and sends out 150 Hz sub-audible data word.

    a. The term "Failsoft Word" is a misnomer. The Failsoft Word is a series of 150 Hz pulses produced by the Trunked Control Module that contains no information as compared to an OSW or LSHS but is used as an indicator to the radio of failsoft operation.

4. Mobiles will respond to data word and unmute, allowing service to continue via community repeater type operation.

5. Base sends out 900 Hz tone for 280 mSec every ten seconds to alert the mobile user that the system is in failsoft.

6. Timeout parameters are changeable to the following:

MICOR REPEATER	MSF5000 REPEATER
1. 2.4 minutes	1. 72.8 Seconds
2. 1.2 minutes	2. 36.4 Seconds
3. .6 minutes	3. 2.3 Seconds
4. .3 minutes	4. 1.1 Seconds
5. 300 mSeconds (Fast Failsoft)	5. .568 Seconds
	6. .284 Seconds

FAILSOFT OPERATION

Mobile scans for control channels. If no recognizable data then mobile reverts to FAILSOFT.

Finding Failsoft Repeaters

1. Code Plug Failsoft option enabled.
2. Radio scans all possible data channels:
    - a. 72.2 mSeconds per channel (3 OSW + 8 bits)
    - b. Searches for a total of 8 sequences:
        - 1). 72.2 mSeconds x 4 Data channels x 8 sequences = 2.31 Seconds.
    - c. Looks for Failsoft Word (Criteria = LSHS = 150 Baud = (6.67 mSeconds x 21 bits = 140 mSeconds).
        - 1). Unmutes if 2 sequential Failsoft Words are detected.
        - 2). Restarts search if Failsoft Word is not detected within 980 mSeconds.

This process is a loop action. The radio will start at step 2 above and concludes if the Failsoft Word is detected twice without encountering a control channel. If the Failsoft Word is not detected and the radio cannot locate a control channel the search will start again (radio may be out of range of the system).

XIII. BOARD CIRCUIT DESCRIPTIONS

1. SITE CONTROLLER BOARD
2. INBOUND RECOVERY BOARD
3. RECEIVER INTERFACE BOARD
4. TRANSMITTER INTERFACE BOARD
5. TRUNK CONTROL MODULE (MICOR)
6. TRUNK CONTROL MODULE (ANALOG MSF-5000)
7. TRUNKED TONE REMOTE CONTROL MODULE (DIGITAL MSF-5000)

SITE CONTROLLER BLOCK DIAGRAM

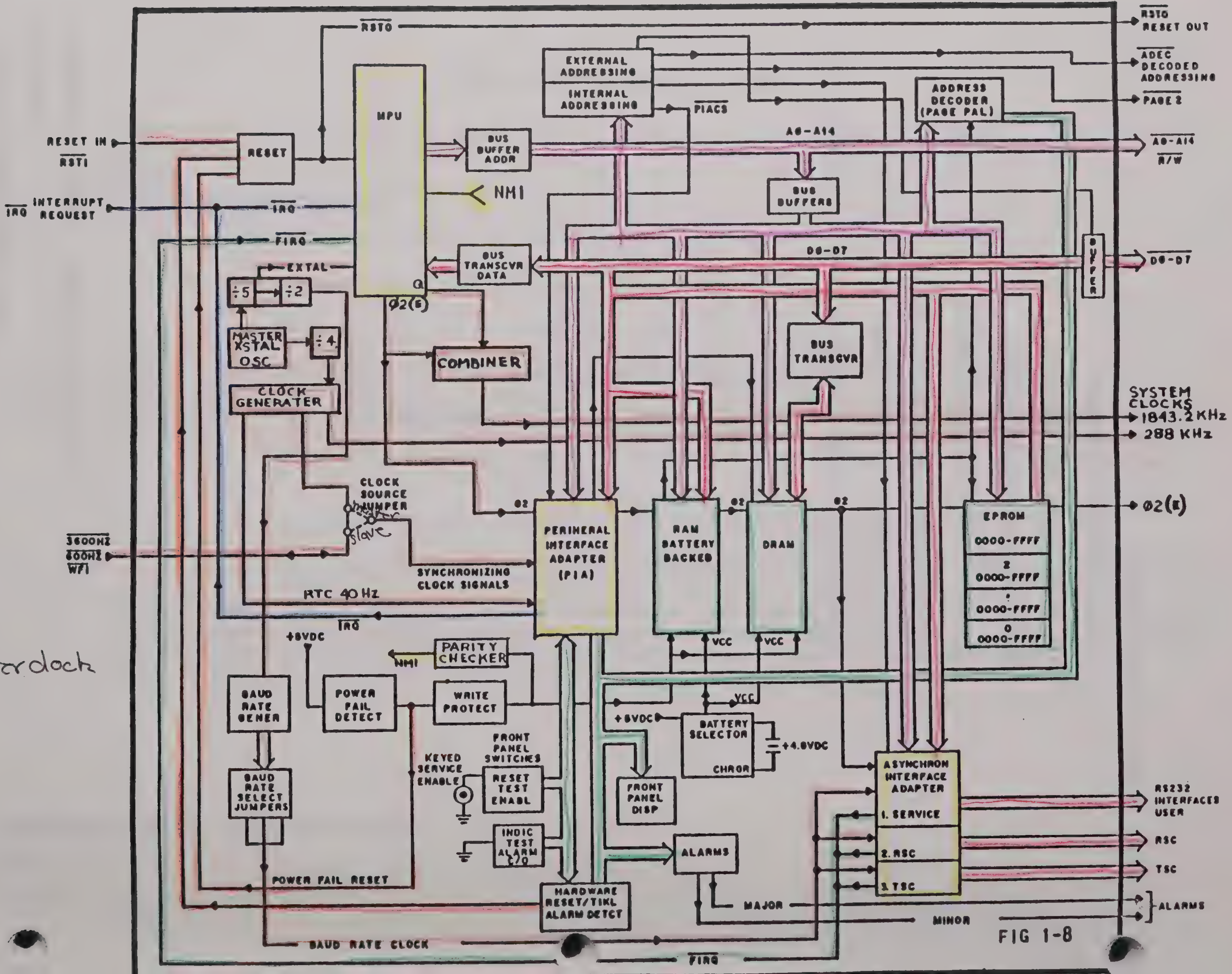
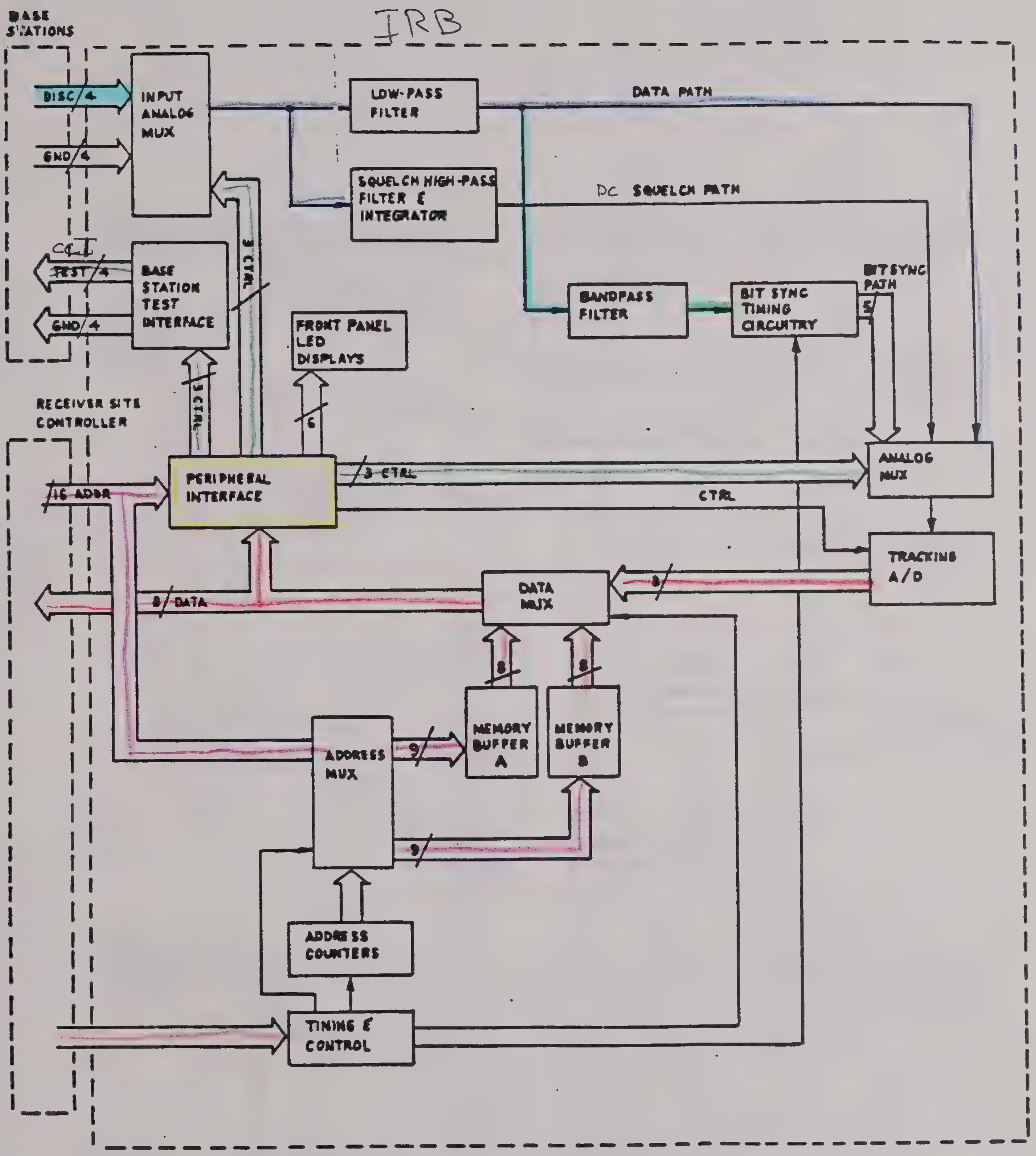

RSTO
RSTO RESET OUT
EXTERNAL ADDRESSING
INTERNAL ADDRESSING
PIACS
ADEC DECODED ADDRESSING
ADDRESS DECODER (PAGE PAL)
PAGE 2
MPU
RESET IN
RSTI
RESET
BUS BUFFER ADDR
A0-A14
A0-A14
R/W
NMI
BUS BUFFERS
IRQ INTERRUPT REQUEST
IRQ
FIRQ
BUS TRANSCVR DATA
D0-D7
BUFFER
D0-D7
EXTAL
÷5
÷2
Q
Ø2(E)
MASTER XSTAL OSC
÷4
COMBINER
BUS TRANSCVR
CLOCK GENERATER
SYSTEM CLOCKS
1843.2 KHz
288 KHz
CLOCK SOURCE JUMPER
master
slave
Ø2
Ø2
Ø2
Ø2(E)
PERIPHERAL INTERFACE ADAPTER (PIA)
RAM BATTERY BACKED
DRAM
EPROM
0000-FFFF
2 0000-FFFF
1 0000-FFFF
0 0000-FFFF
3600HZ
600HZ
WFI
SYNCHRONIZING CLOCK SIGNALS
RTC 40 Hz
IRQ
VCC
VCC
+5VDC
NMI
PARITY CHECKER
BAUD RATE GENER
POWER FAIL DETECT
WRITE PROTECT
VCC
+5VDC
BATTERY SELECTOR
+4.5VDC
CHROR
KEYED SERVICE ENABLE
FRONT PANEL SWITCHES
RESET TEST ENABL
FRONT PANEL DISP
BAUD RATE SELECT JUMPERS
ASYNCHRON INTERFACE ADAPTER
1. SERVICE
2. RSC
3. TSC
RS232 INTERFACES USER
RSC
TSC
INDIC TEST ALARM I/O
ALARMS
POWER FAIL RESET
HARDWARE RESET/TIKL ALARM DETCT
MAJOR
MINOR
ALARMS
BAUD RATE CLOCK
FIRQ

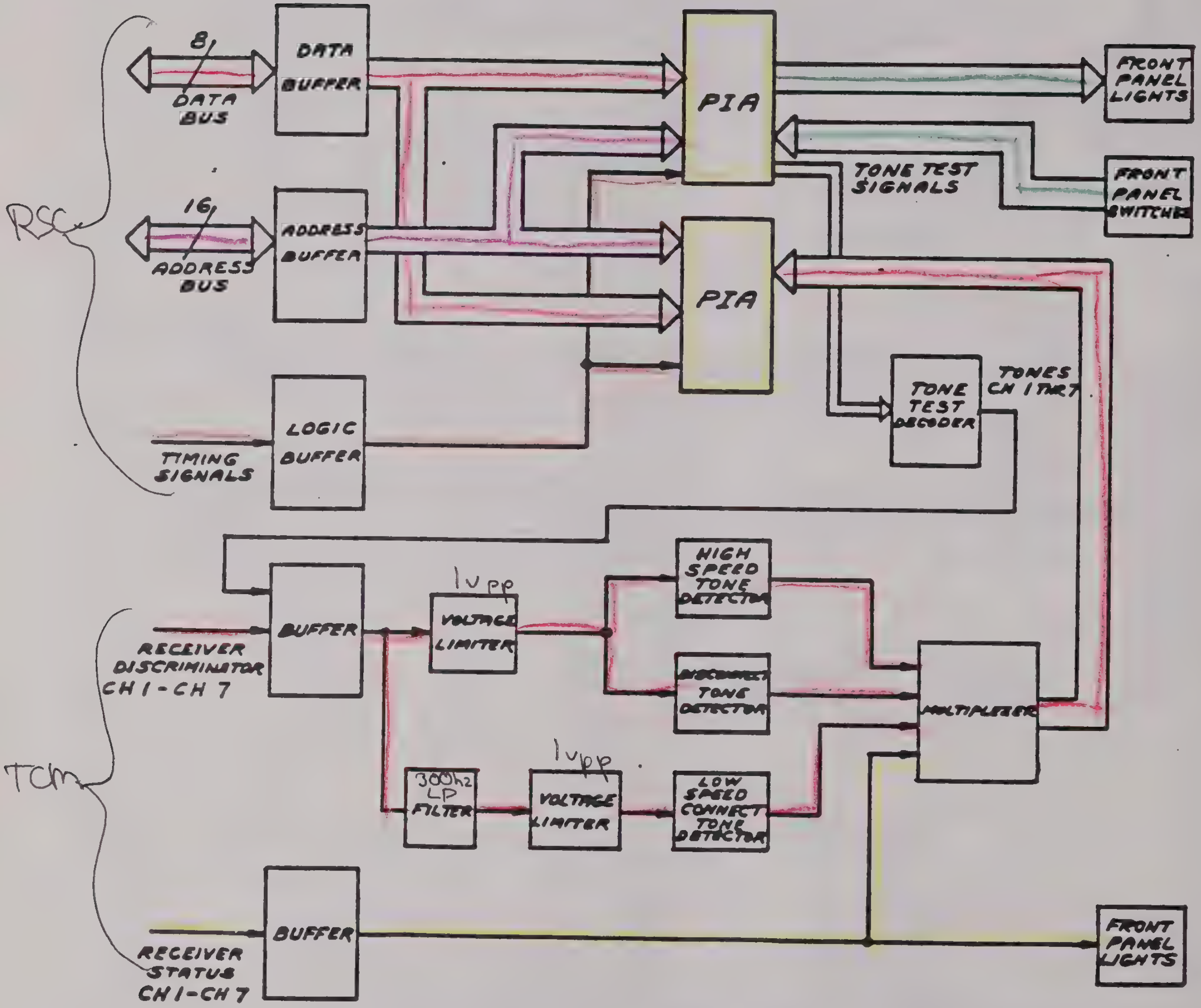
FIG 1-8

TSC master clock


IRB
BASE STATIONS
DISC/4
GND/4
INPUT ANALOG MUX
LOW-PASS FILTER
DATA PATH
SQUELCH HIGH-PASS FILTER & INTEGRATOR
DC SQUELCH PATH
CAL TEST/4
GND/4
BASE STATION TEST INTERFACE
3 CTRL
BANDPASS FILTER
BIT SYNC TIMING CIRCUITRY
BIT SYNC PATH
5
FRONT PANEL LED DISPLAYS
3 CTRL
6
RECEIVER SITE CONTROLLER
16 ADDR
PERIPHERAL INTERFACE
3 CTRL
ANALOG MUX
CTRL
TRACKING A/D
8
DATA MUX
8/DATA
8
8
MEMORY BUFFER A
MEMORY BUFFER B
ADDRESS MUX
9
9
ADDRESS COUNTERS
TIMING & CONTROL

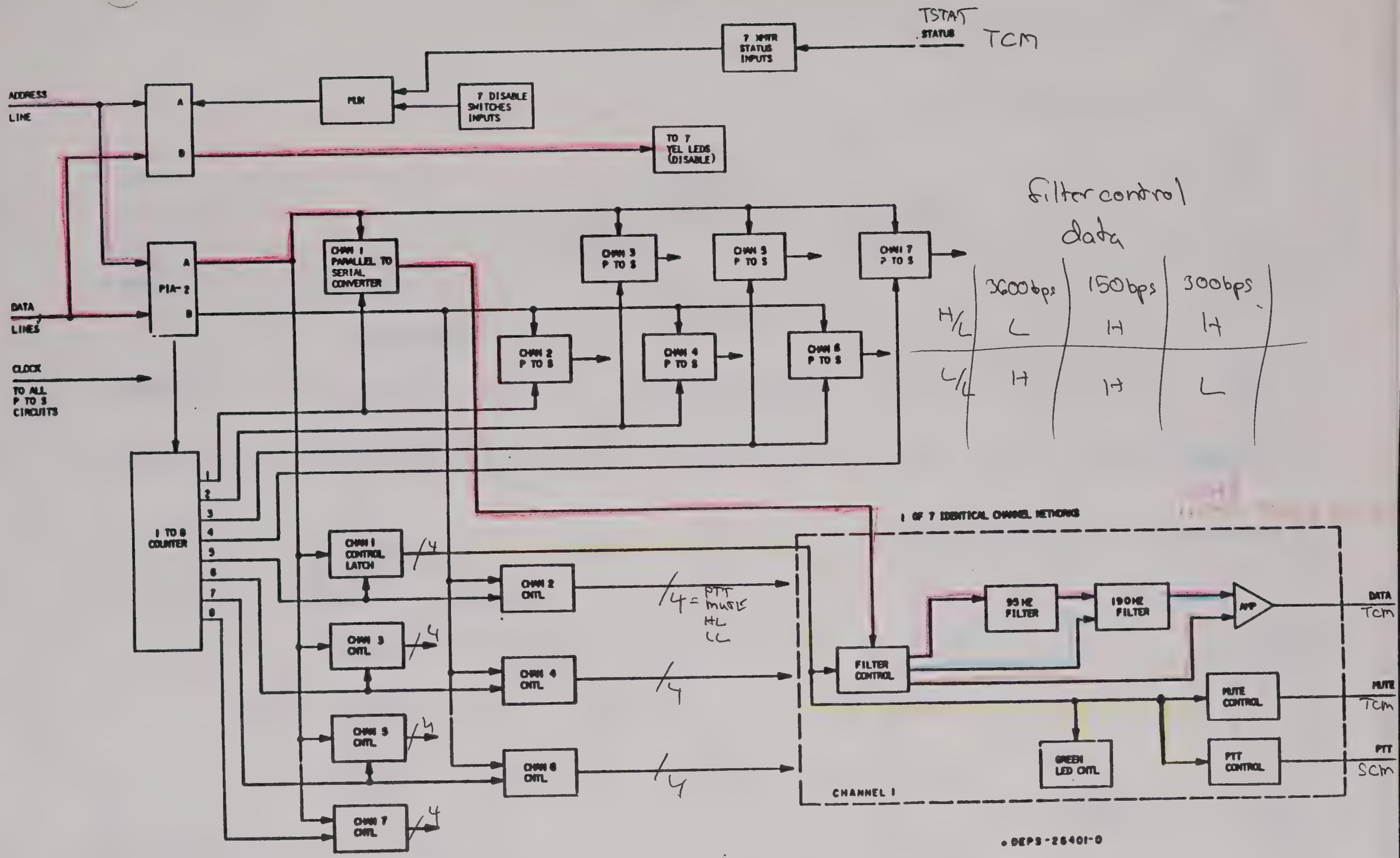
CEPS-26389-0

RIB


8
DATA BUS
DATA BUFFER
PIA
FRONT PANEL LIGHTS
FRONT PANEL SWITCHES
TONE TEST SIGNALS
RSC
16
ADDRESS BUS
ADDRESS BUFFER
PIA
TONE TEST DECODER
TONES CH 1 THRU 7
TIMING SIGNALS
LOGIC BUFFER
1vpp
HIGH SPEED TONE DETECTOR
RECEIVER DISCRIMINATOR CH 1-CH 7
BUFFER
VOLTAGE LIMITER
DISCONNECT TONE DETECTOR
MULTIPLEXER
TCM
300hz LP FILTER
1vpp
VOLTAGE LIMITER
LOW SPEED CONNECT TONE DETECTOR
RECEIVER STATUS CH 1-CH 7
BUFFER
FRONT PANEL LIGHTS

•CEPS-26395-0

TIB

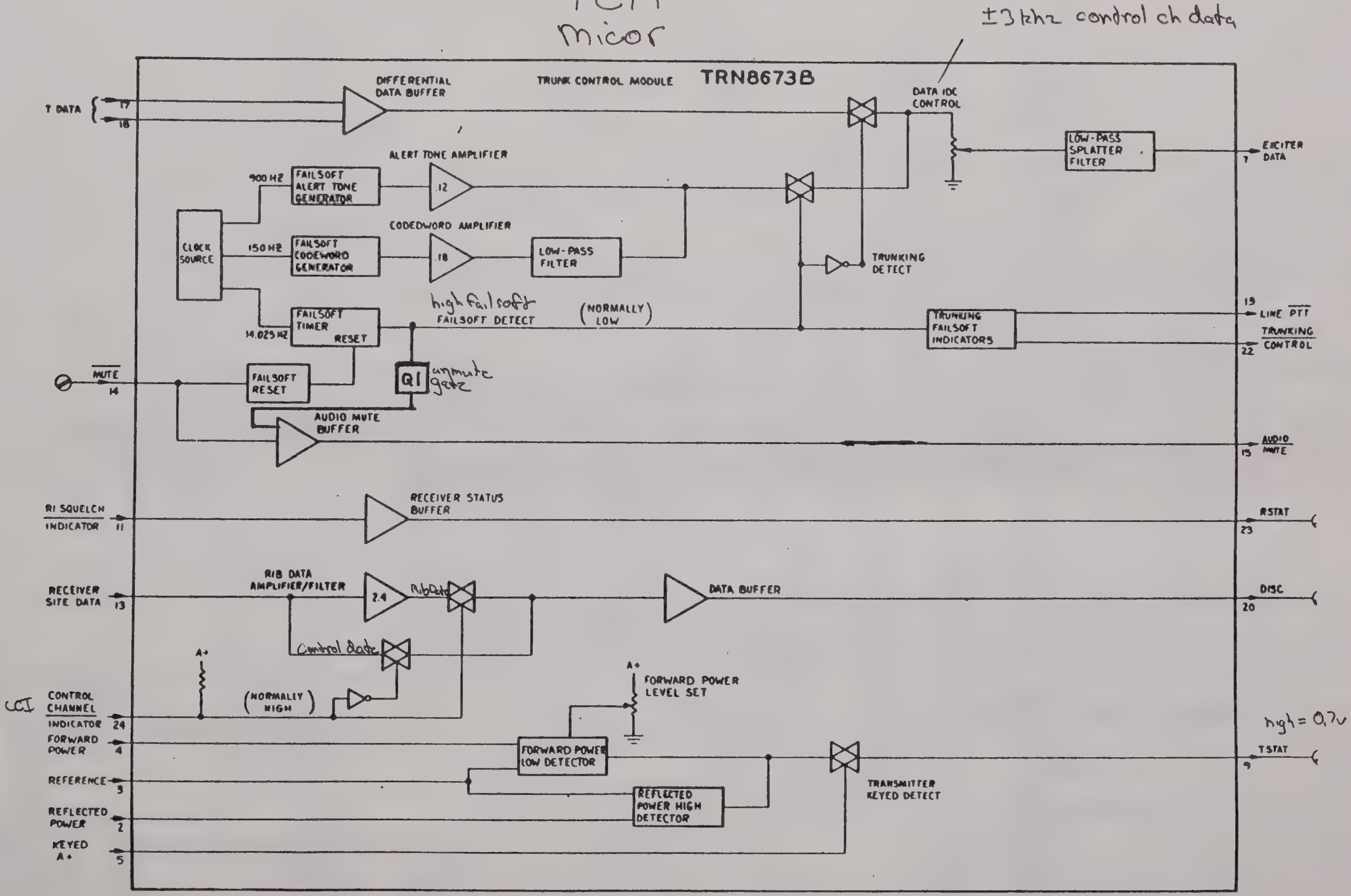

TSTAT
STATUS
TCM
7 INPUT STATUS INPUTS
MUX
7 DISABLE SWITCHES INPUTS
ADDRESS LINE
A
B
TO 7 YEL LEDS (DISABLE)
PIA-2
DATA LINES
CLOCK TO ALL P TO S CIRCUITS
CHAN 1 PARALLEL TO SERIAL CONVERTER
CHAN 2 P TO S
CHAN 3 P TO S
CHAN 4 P TO S
CHAN 5 P TO S
CHAN 6 P TO S
CHAN 7 P TO S
1 TO 8 COUNTER
1
2
3
4
5
6
7
8
CHAN 1 CONTROL LATCH
CHAN 2 CNTL
CHAN 3 CNTL
CHAN 4 CNTL
CHAN 5 CNTL
CHAN 6 CNTL
CHAN 7 CNTL
4
4 = PTT mute HL LL
1 OF 7 IDENTICAL CHANNEL NETWORKS
FILTER CONTROL
95 HZ FILTER
190 HZ FILTER
AMP
DATA
Tcm
MUTE CONTROL
MUTE
Tcm
GREEN LED CNTL
PTT CONTROL
PTT
Scm
CHANNEL 1

filter control data

	3600bps	150bps	300bps
H/L	L	H	H
L/L	H	H	L

DEPS-26401-0

TCM
micor

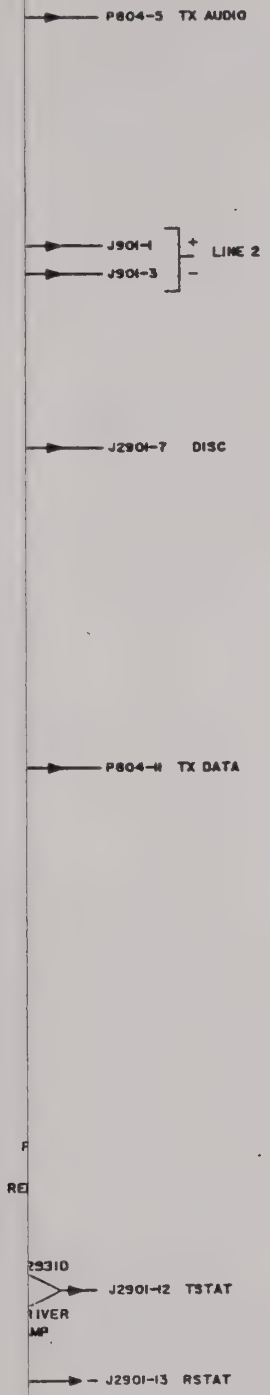

±3 khz control ch data
TRUNK CONTROL MODULE
TRN8673B
T DATA
17
18
DIFFERENTIAL DATA BUFFER
DATA I/OC CONTROL
LOW-PASS SPLATTER FILTER
EXCITER DATA
7
ALERT TONE AMPLIFIER
900 HZ
FAILSOFT ALERT TONE GENERATOR
.12
CLOCK SOURCE
150 HZ
FAILSOFT CODEWORD GENERATOR
CODEWORD AMPLIFIER
.18
LOW-PASS FILTER
TRUNKING DETECT
high failsoft
FAILSOFT DETECT
(NORMALLY LOW)
FAILSOFT TIMER
RESET
14.025 HZ
19
LINE PTT
TRUNKING FAILSOFT INDICATORS
TRUNKING CONTROL
22
MUTE
14
FAILSOFT RESET
Q1
unmute gate
AUDIO MUTE BUFFER
AUDIO MUTE
15
RI SQUELCH INDICATOR
11
RECEIVER STATUS BUFFER
RSTAT
23
RECEIVER SITE DATA
13
RIB DATA AMPLIFIER/FILTER
2.4
RibData
DATA BUFFER
DISC
20
Control data
A+
CCI
CONTROL CHANNEL INDICATOR
24
(NORMALLY HIGH)
A+
FORWARD POWER LEVEL SET
FORWARD POWER
4
FORWARD POWER LOW DETECTOR
high = 0.7v
TSTAT
9
REFERENCE
3
REFLECTED POWER HIGH DETECTOR
TRANSMITTER KEYED DETECT
REFLECTED POWER
2
KEYED A+
5

DEPS-34114-0

Analog MSF 5000

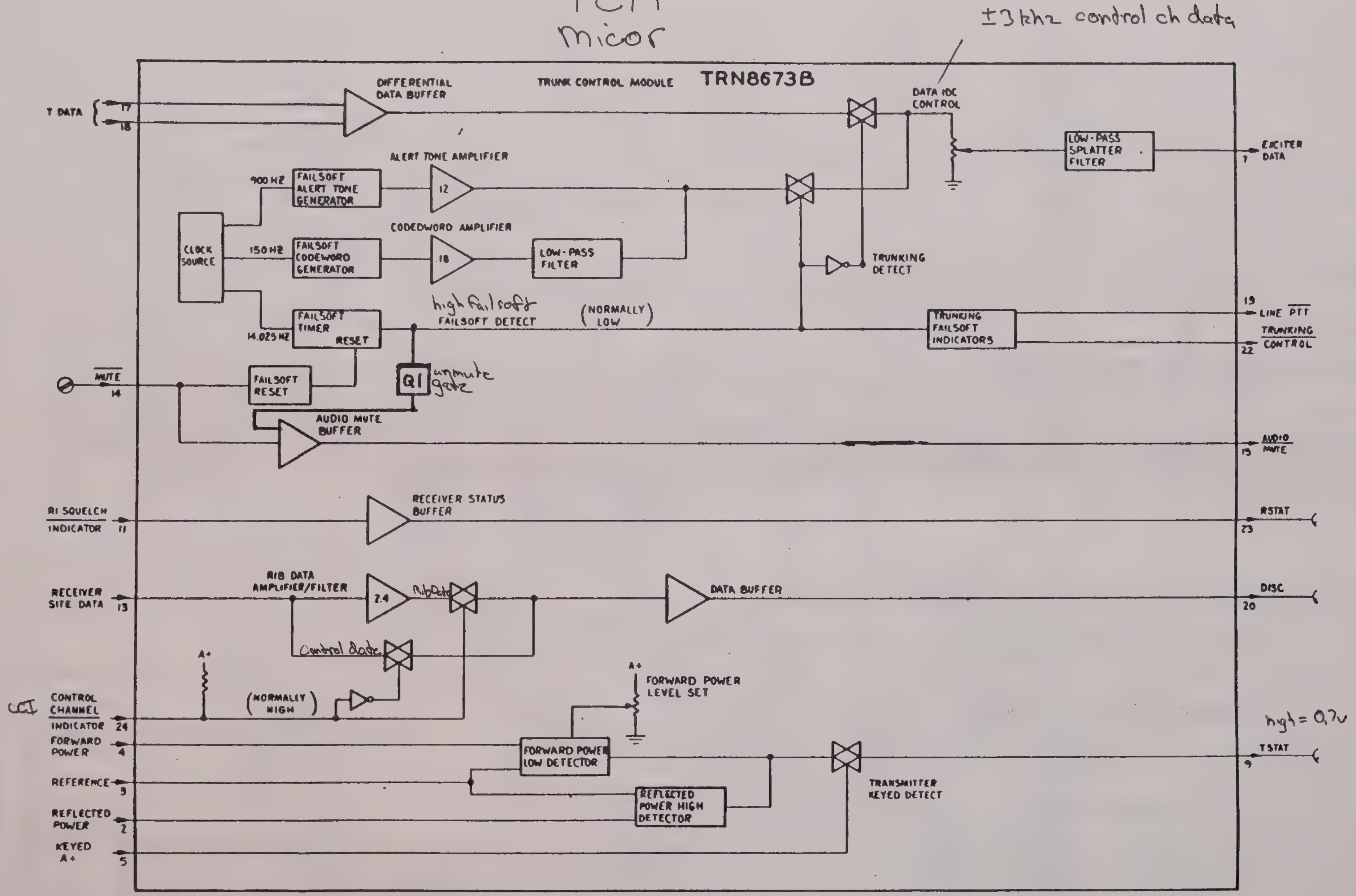
TRUNK CONTROL MODULE

FUNCTIONAL BLOCK DIAGRAM


P804-5 TX AUDIO
J901-1
J901-3
+
−
LINE 2
J2901-7 DISC
P804-11 TX DATA
J2901-12 TSTAT
J2901-13 RSTAT

Schematic Diagram
On Next Page

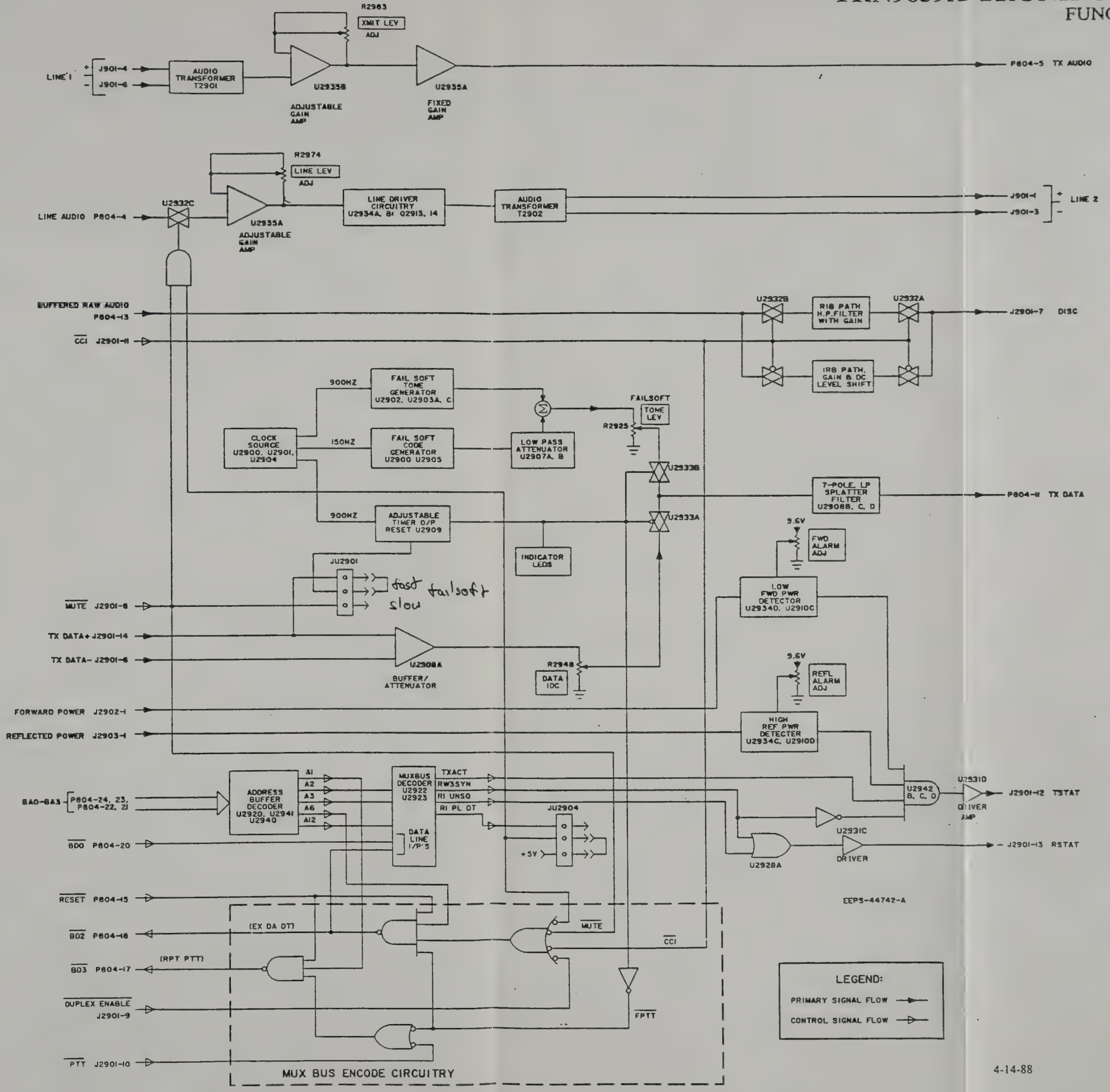
TCM
micor


±3khz control ch data
TRUNK CONTROL MODULE
TRN8673B
T DATA
17
18
DIFFERENTIAL DATA BUFFER
DATA IDC CONTROL
LOW-PASS SPLATTER FILTER
7
EXCITER DATA
ALERT TONE AMPLIFIER
900 HZ
FAILSOFT ALERT TONE GENERATOR
12
CLOCK SOURCE
CODEWORD AMPLIFIER
150 HZ
FAILSOFT CODEWORD GENERATOR
18
LOW-PASS FILTER
TRUNKING DETECT
14.025 HZ
FAILSOFT TIMER
RESET
high failsoft
FAILSOFT DETECT
(NORMALLY LOW)
TRUNKING FAILSOFT INDICATORS
19
LINE PTT
TRUNKING CONTROL
22
MUTE
14
FAILSOFT RESET
Q1
unmute gate
AUDIO MUTE BUFFER
AUDIO MUTE
15
RI SQUELCH INDICATOR
11
RECEIVER STATUS BUFFER
RSTAT
23
RECEIVER SITE DATA
13
RIB DATA AMPLIFIER/FILTER
2.4
Rib Data
DATA BUFFER
DISC
20
Control data
A+
CCI
CONTROL CHANNEL INDICATOR
24
(NORMALLY HIGH)
A+
FORWARD POWER LEVEL SET
FORWARD POWER
4
FORWARD POWER LOW DETECTOR
high = 0.7v
TSTAT
9
REFERENCE
3
REFLECTED POWER
2
REFLECTED POWER HIGH DETECTOR
TRANSMITTER KEYED DETECT
KEYED A+
5

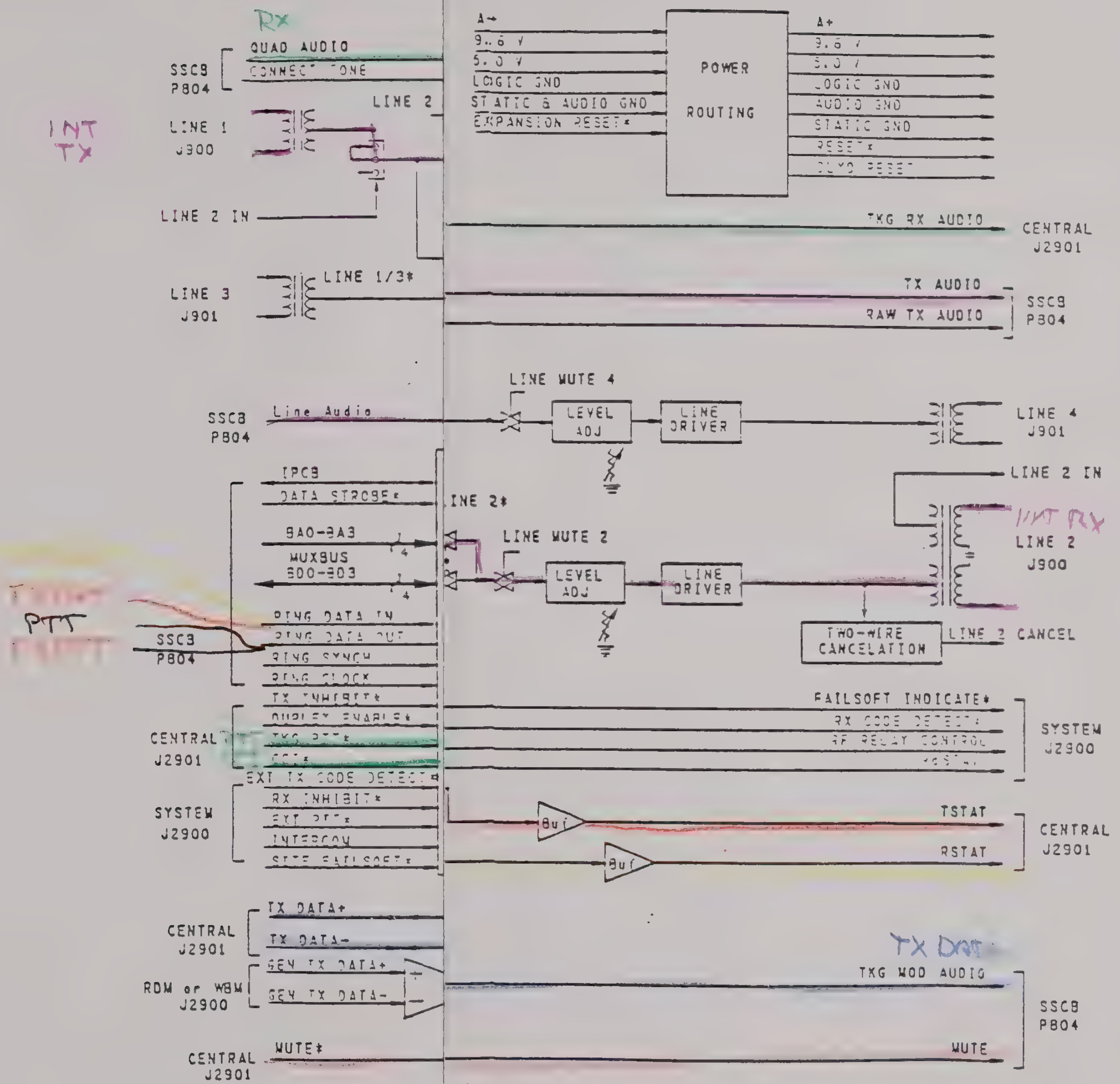
DEPS-34114-0

Analog MSF 5000

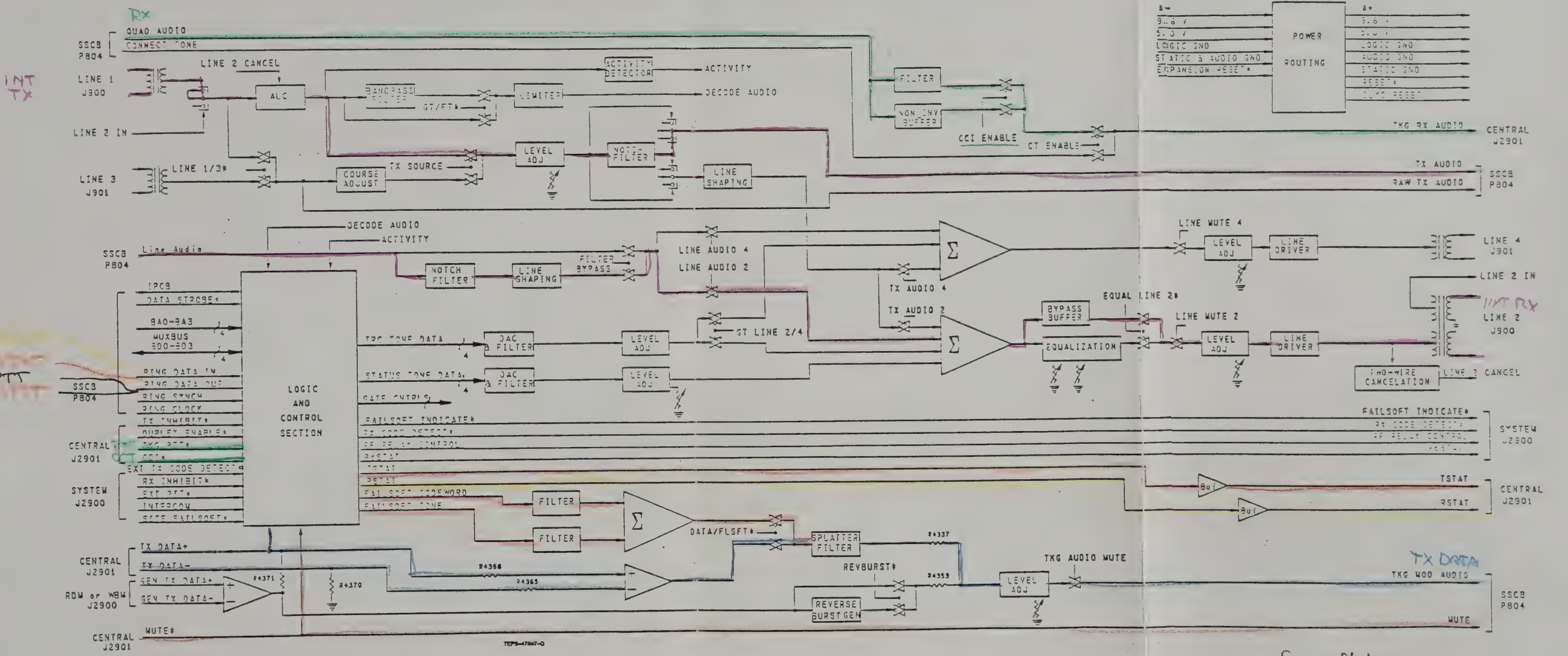
TRN9839A TRUNK CONTROL MODULE
FUNCTIONAL BLOCK DIAGRAM


R2983
XMIT LEV ADJ
LINE 1
J901-4
J901-6
AUDIO TRANSFORMER T2901
U2935B
ADJUSTABLE GAIN AMP
U2935A
FIXED GAIN AMP
P804-5 TX AUDIO
R2974
LINE LEV ADJ
LINE AUDIO P804-4
U2932C
U2935A
ADJUSTABLE GAIN AMP
LINE DRIVER CIRCUITRY U2934A, B; Q2913, 14
AUDIO TRANSFORMER T2902
J901-1
J901-3
LINE 2
BUFFERED RAW AUDIO P804-13
CCI J2901-11
U2932B
RIB PATH H.P. FILTER WITH GAIN
U2932A
J2901-7 DISC
IRB PATH, GAIN & DC LEVEL SHIFT
900HZ
FAIL SOFT TONE GENERATOR U2902, U2903A, C
FAILSOFT TONE LEV
R2925
CLOCK SOURCE U2900, U2901, U2904
150HZ
FAIL SOFT CODE GENERATOR U2900 U2905
LOW PASS ATTENUATOR U2907A, B
U2933B
7-POLE, LP SPLATTER FILTER U2908B, C, D
P804-11 TX DATA
900HZ
ADJUSTABLE TIMER O/P RESET U2909
U2933A
INDICATOR LEDS
9.6V
FWD ALARM ADJ
JU2901
fast
slow
failsoft
LOW FWD PWR DETECTOR U2934D, U2910C
MUTE J2901-8
TX DATA+ J2901-14
TX DATA- J2901-6
U2908A
BUFFER/ ATTENUATOR
R2948
DATA IDC
9.6V
REFL ALARM ADJ
FORWARD POWER J2902-1
REFLECTED POWER J2903-1
HIGH REF PWR DETECTER U2934C, U2910D
BA0-BA3
P804-24, 23, P804-22, 21
ADDRESS BUFFER DECODER U2920, U2941 U2940
A1
A2
A3
A6
A12
MUXBUS DECODER U2922 U2923
TXACT
RW3SYN
RI UNSQ
RI PL DT
DATA LINE I/P'S
JU2904
+5V
U2942 B, C, D
U2931D
DRIVER AMP
J2901-12 TSTAT
U2931C
U2928A
DRIVER
J2901-13 RSTAT
BDO P804-20
RESET P804-15
BD2 P804-16
BD3 P804-17
DUPLEX ENABLE J2901-9
PTT J2901-10
(EX DA DT)
(RPT PTT)
MUTE
CCI
FPTT
MUX BUS ENCODE CIRCUITRY
EEPS-44742-A
LEGEND:
PRIMARY SIGNAL FLOW
CONTROL SIGNAL FLOW

Schematic Diagram On Next Page


RX
SSCB P804
QUAD AUDIO
CONNECT TONE
INT TX
LINE 1 J900
LINE 2
LINE 2 IN
LINE 3 J901
LINE 1/3*
A+
9.6 V
5.0 V
LOGIC GND
STATIC & AUDIO GND
EXPANSION RESET*
POWER ROUTING
AUDIO GND
STATIC GND
RESET*
TKG RX AUDIO
CENTRAL J2901
TX AUDIO
RAW TX AUDIO
LINE MUTE 4
Line Audio
LEVEL ADJ
LINE DRIVER
LINE 4 J901
IPCB
DATA STROBE*
LINE 2*
BA0-BA3
MUXBUS BD0-BD3
LINE MUTE 2
LINE 2 IN
INT RX
LINE 2 J900
PTT
RING DATA IN
RING DATA OUT
RING SYNCH
RING CLOCK
TWO-WIRE CANCELATION
LINE 2 CANCEL
TX INHIBIT*
DUPLEX ENABLE*
TKG PTT*
COI*
FAILSOFT INDICATE*
RX CODE DETECT*
RF RELAY CONTROL
SYSTEM J2900
EXT TX CODE DETECT*
RX INHIBIT*
EXT PTT*
INTERCOM
SITE FAILSOFT*
Buf
TSTAT
RSTAT
TX DATA+
TX DATA-
GEN TX DATA+
GEN TX DATA-
RDM or WBM J2900
TX DAT
TKG MOD AUDIO
MUTE*
MUTE

Secure Station
Control board


RX
SSCB P804
QUAD AUDIO
CONNECT TONE
INT TX
LINE 1 J900
LINE 2 CANCEL
ALC
BANDPASS FILTER
GT/FT*
LIMITER
ACTIVITY DETECTOR
ACTIVITY
DECODE AUDIO
LINE 2 IN
LINE 3 J901
LINE 1/3*
COURSE ADJUST
TX SOURCE
LEVEL ADJ
NOTCH FILTER
LINE SHAPING
FILTER
NON INV BUFFER
CCI ENABLE
CT ENABLE
TKG RX AUDIO
CENTRAL J2901
TX AUDIO
RAW TX AUDIO
SSCB P804
A-
9.6 V
5.0 V
LOGIC GND
STATIC & AUDIO GND
EXPANSION RESET*
POWER ROUTING
A+
9.6 V
5.0 V
LOGIC GND
AUDIO GND
STATIC GND
RESET*
DUMP RESET
DECODE AUDIO
ACTIVITY
SSCB P804
Line Audio
NOTCH FILTER
LINE SHAPING
FILTER BYPASS
LINE AUDIO 4
LINE AUDIO 2
TX AUDIO 4
TX AUDIO 2
GT LINE 2/4
Σ
LINE MUTE 4
LEVEL ADJ
LINE DRIVER
LINE 4 J901
LINE 2 IN
INT RX
LINE 2 J900
EQUAL LINE 2*
BYPASS BUFFER
EQUALIZATION
LINE MUTE 2
TWO-WIRE CANCELATION
LINE 2 CANCEL
IPCB
DATA STROBE*
BA0-BA3
MUXBUS BD0-BD3
TX/RX PTT
SSCB P804
RING DATA IN
RING DATA OUT
RING SYNCH
RING CLOCK
TX INHIBIT*
DUPLEX ENABLE*
TKG PTT*
CCI*
CENTRAL J2901
CCT
EXT TX CODE DETECT*
RX INHIBIT*
EXT PTT*
INTERCOM
SITE FAILSOFT*
SYSTEM J2900
LOGIC AND CONTROL SECTION
TDC TONE DATA
STATUS TONE DATA
DAC FILTER
GATE CNTRLS
FAILSOFT INDICATE*
RX CODE DETECT*
RF RELAY CONTROL
RSTAT
TSTAT
FAILSOFT CODEWORD
FAILSOFT TONE
FAILSOFT INDICATE*
RX CODE DETECT*
RF RELAY CONTROL
RSTAT
SYSTEM J2900
TSTAT
RSTAT
Buf
CENTRAL J2901
FILTER
DATA/FLSFT*
SPLATTER FILTER
CENTRAL J2901
TX DATA+
TX DATA-
ROM or WBM J2900
GEN TX DATA+
GEN TX DATA-
R4371
R4370
R4366
R4365
R4337
R4353
REVBURST*
REVERSE BURST GEN
TKG AUDIO MUTE
TX DATA
TKG MOD AUDIO
SSCB P804
MUTE*
MUTE
CENTRAL J2901
TEPS-47847-O

Secure Station
Control board

Digital MSF5000

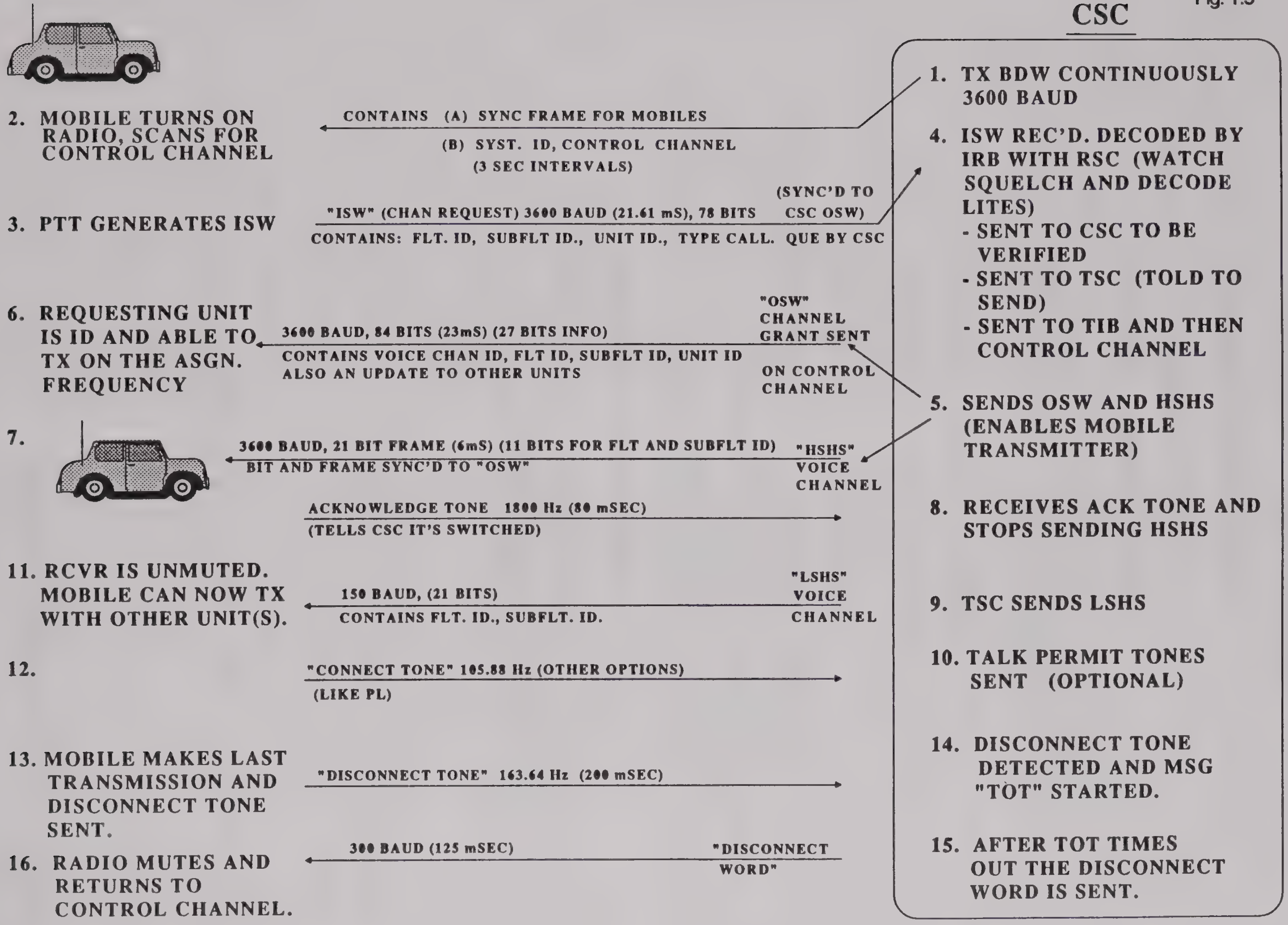
TRUNKED TONE REMOTE CONTROL MODULE

BLOCK DIAGRAM

TCM BOARD DIAGRAM FOR ANALOG MSF-5000

TTRC BORAD DIAGRAM FOR DIGITAL MSF-5000

Fig. 1.5



CSC

1. TX BDW CONTINUOUSLY 3600 BAUD

CONTAINS (A) SYNC FRAME FOR MOBILES
(B) SYST. ID, CONTROL CHANNEL
(3 SEC INTERVALS)

2. MOBILE TURNS ON RADIO, SCANS FOR CONTROL CHANNEL

3. PTT GENERATES ISW

"ISW" (CHAN REQUEST) 3600 BAUD (21.61 mS), 78 BITS (SYNC'D TO CSC OSW)
CONTAINS: FLT. ID, SUBFLT ID., UNIT ID., TYPE CALL. QUE BY CSC

4. ISW REC'D. DECODED BY IRB WITH RSC (WATCH SQUELCH AND DECODE LITES)
- SENT TO CSC TO BE VERIFIED
- SENT TO TSC (TOLD TO SEND)
- SENT TO TIB AND THEN CONTROL CHANNEL

5. SENDS OSW AND HSHS (ENABLES MOBILE TRANSMITTER)

"OSW" CHANNEL GRANT SENT ON CONTROL CHANNEL
3600 BAUD, 84 BITS (23mS) (27 BITS INFO)
CONTAINS VOICE CHAN ID, FLT ID, SUBFLT ID, UNIT ID
ALSO AN UPDATE TO OTHER UNITS

6. REQUESTING UNIT IS ID AND ABLE TO TX ON THE ASGN. FREQUENCY

7.

"HSHS" VOICE CHANNEL
3600 BAUD, 21 BIT FRAME (6mS) (11 BITS FOR FLT AND SUBFLT ID)
BIT AND FRAME SYNC'D TO "OSW"

ACKNOWLEDGE TONE 1800 Hz (80 mSEC)
(TELLS CSC IT'S SWITCHED)

8. RECEIVES ACK TONE AND STOPS SENDING HSHS

9. TSC SENDS LSHS

"LSHS" VOICE CHANNEL
150 BAUD, (21 BITS)
CONTAINS FLT. ID., SUBFLT. ID.

11. RCVR IS UNMUTED. MOBILE CAN NOW TX WITH OTHER UNIT(S).

10. TALK PERMIT TONES SENT (OPTIONAL)

12.

"CONNECT TONE" 105.88 Hz (OTHER OPTIONS)
(LIKE PL)

13. MOBILE MAKES LAST TRANSMISSION AND DISCONNECT TONE SENT.

"DISCONNECT TONE" 163.64 Hz (200 mSEC)

14. DISCONNECT TONE DETECTED AND MSG "TOT" STARTED.

15. AFTER TOT TIMES OUT THE DISCONNECT WORD IS SENT.

"DISCONNECT WORD"
300 BAUD (125 mSEC)

16. RADIO MUTES AND RETURNS TO CONTROL CHANNEL.

Trunk System Signaling

(FIXED-END)

CONTROL CHANNEL - TRANSMIT

1. Background data word at 3600 baud
2. Outbound signaling word at 3600 baud
3. System ID (at least) every 3 seconds

CONTROL CHANNEL - RECEIVE

1. Inbound signaling word at 3600 baud

VOICE CHANNEL - TRANSMIT

1. High speed handshake at 3600 baud (800 MHz)
2. Connect word/low speed handshake at 150 baud.
3. Disconnect word at 300 baud
4. Failsoft at 150 Hz
5. Normal voice communications

VOICE CHANNEL - RECEIVE

1. Acknowledge tone at 1800 Hz (800 MHz)
2. Connect tone at 105 Hz (SP)
3. Disconnect tone at 163 Hz
4. Normal voice communications

Trunking - General Quiz 2

1. It is possible for an individual radio to be programmed for more than one subfleet.

   __X__ True ______ False

2. How often is the "Background Data Word Frame" transmitted on the control channel?

   A. At least every 3 seconds

   [✓ B.] Continuously

   C. When a voice channel is available

   D. During control channel idle time

3. The "Inbound Signaling Word" is a request for a voice channel. It contains information such as the fleet ID, subfleet ID, individual ID, and _____?

   A. Vacant voice channel information

   B. Control channel frequency

   [✓ C.] Call type information

   D. Central controller ID

4. The connect tone is sent by the originating mobile and is used to inform the central controller of _____?

   [✓ A.] Voice channel activity

   B. Type of call

   C. Subfleet structure

   D. System ID

5. The code plug in the mobile or portable radio determines the personality of the radio.

   __X__ True _____ False

6. Along with the "Background Data Word Frame," the central controller sends the _______________ on the control channel.

   A. High speed handshake

   B. Low speed handshake

   [✓ C.] Outbound signaling word

   D. Connect tone

7. With a properly equipped radio, an individual in a fleet can make a transmission to the entire fleet.

   __X__ True _____ False

8. The "Low Speed Handshake" is sent on the assigned voice channel, and when received by the radio __________.

[✓ A.] Un-squelches all concerned receivers
C. Returns them to the control channel
B. Allows initiating transmitter to transmit
D. All of the above

9. If a radio is turned on while its subfleet is active on a call, it will read the "Outbound Signaling Word" sent on the control channel and be sent to the proper voice channel to join its subfleet. This feature is known as _____?

[✓ A.] Continuous assignment updating
C. Trunking
B. Automatic re-try
D. None of the above

10. The "Background Data Word" is used to synchronize all radios for the data transfers.

X True _____ False

11. In a message trunked call, when a radio is un-keyed, the radio does not immediately send a disconnect tone.

_____ True X False

12. When a fleet or system call is initiated, all active subfleet calls __________.

A. Drop to the control channel
C. Hear the initiators message
B. Become message trunked
[✓ D.] Become transmission trunked

13. In a transmission trunked call, when the central controller receives the disconnect tone, it immediately __________.

A. Starts the time-out timer
C. Sends the channel assignment information
[✓ B.] Sends the disconnect word
D. Looks for a vacant voice channel

14. The "High Speed Handshake" and "Low Speed Handshake" (or Connect Word) are transmitted on the assigned voice channel.

X True _____ False

15. The repeater drop-out timer is used in what type of trunking?

[✓ A.] Message   B. Transmission

16. When an operator initiates a call and all voice channels are occupied, the request will be put into __________.

A. The code plug   [✓ C.] The waiting queue

B. The Outbound Signaling Word   D. Continuous assignment updating

17. When an operator receives the audible system busy condition, the operator should try again later to access the system.

_____ True   [✓ False]

18. Of the following, which type of call has highest priority in the waiting queue?

A. Subfleet calls   C. Fleet calls

[✓ B.] System calls

19. All of the types of calls discussed so far use the same signaling format.

[✓ True]   _____ False

20. The form of trunking (message or transmission) is determined by __________.

A. The waiting queue   C. The Disconnect Tone

[✓ B.] The type of call   D. The Disconnect Word

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TYPE II
OVERVIEW

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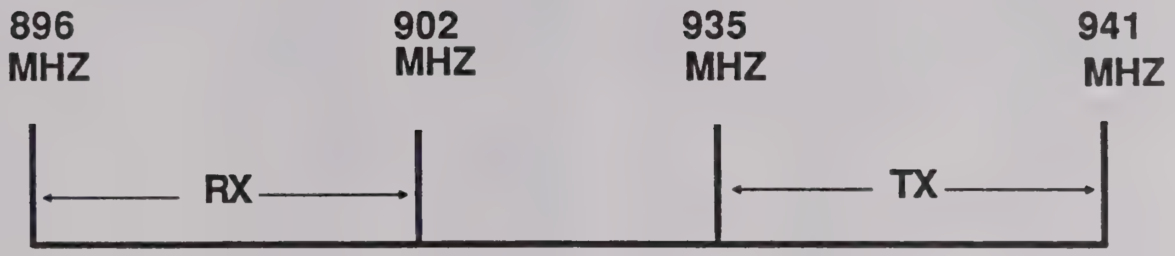
896 MHZ TRUNKING SPECTRUM


896
MHZ
902
MHZ
935
MHZ
941
MHZ
RX
TX

1ST RX CHANNEL = 896.0125 MHZ

1ST TX CHANNEL = 935.0125 MHZ

TX - RX SEPARATION = 39 MHZ

CHANNEL SEPARATION = 12.5 KHZ

DEVIATION

MAXIMUM DEVIATION = +/- 2.5 KHZ

CONTROL CHANNEL H.S.D. = +/- 1.5 KHZ = 60% +/- 5%

CONNECT TONE = +/- 500 HZ = 20%+ /- 5%

Fig. 1.2.1

MOTOROLA'S 900 MHz FREQUENCY SPECTRUM

CHAN #	RECEIVE FREQ.	TRANSMIT FREQ.	CHAN #	RECEIVE FREQ.	TRANSMIT FREQ.
0	8960125	9350125	46	8965875	9355875
1	8960250	9350250	47	8966000	9356000
2	8960375	9350375	48	8966125	9356125
3	8960500	9350500	49	8966250	9356250
4	8960625	9350625	50	8966375	9356375
5	8960750	9350750	51	8966500	9356500
6	8960875	9350875	52	8966625	9356625
7	8961000	9351000	53	8966750	9356750
8	8961125	9351125	54	8966875	9356875
9	8961250	9351250	55	8967000	9357000
10	8961375	9351375	56	8967125	9357125
11	8961500	9351500	57	8967250	9357250
12	8961625	9351625	58	8967375	9357375
13	8961750	9351750	59	8967500	9357500
14	8961875	9351875	60	8967625	9357625
15	8962000	9352000	61	8967750	9357750
16	8962125	9352125	62	8967875	9357875
17	8962250	9352250	63	8968000	9358000
18	8962375	9352375	64	8968125	9358125
19	8962500	9352500	65	8968250	9358250
20	8962625	9352625	66	8968375	9358375
21	8962750	9352750	67	8968500	9358500
22	8962875	9352875	68	8968625	9358625
23	8963000	9353000	69	8968750	9358750
420	9012625	9402625	469	9018750	9408750
421	9012750	9402750	470	9018875	9408875
422	9012875	9402875	471	9019000	9402000
423	9013000	9403000	472	9019125	9409125
424	9013125	9403125	473	9019250	9409250
425	9013250	9403250	474	9019375	9409375
426	9013375	9403375	475	9019500	9409500
427	9013500	9403500	476	9019625	9409625
428	9013625	9403625	477	9019750	9409750
429	9013750	9403750	478	9019875	9409875
430	9013875	9403875	479	9020000	9410000
431	9014000	9404000			
432	9014125	9404125			
433	9014250	9404250			
434	9014375	9404375			

TYPE II TRUNKING OVERVIEW

I. Type II ID's :

- A. Universal.
    - 1. A unique 4 digit (hex) number assigned to each user on a system.
    - 2. This number does not contain any Fleet or Subfleet information.
    - 3. The user only has one ID per system. This makes it easier to locate individuals for private type calls such as call alert, private conversation, and interconnect.
    - 4. The decimal conversion of this ID is the land to mobile ID for interconnect.
    - 5. There are up to 48,000 ID's on a system.
        - FFFF
        - a. 0001 to BFFF hex.
        - b. 0001 to 48,000 dec.
        - 65,000
- B. Talk group.
    - 1. A unique 3 digit (hex) number which represents a group of users on the system.
    - 2. Any number of units can be assigned to a talk group.
    - 3. The number of talk groups the radio may be programmed to operate in, depends on the number of trunked modes available.
    - 4. The System may have up to 2048 talk groups with priority monitor, and 4096 with out. Priority monitor is an option that allows Talk groups involved in an active call to be notified over the voice channel when a priority call is taking place.
    - 5. The radio's programming defines the talk groups it may operate in.

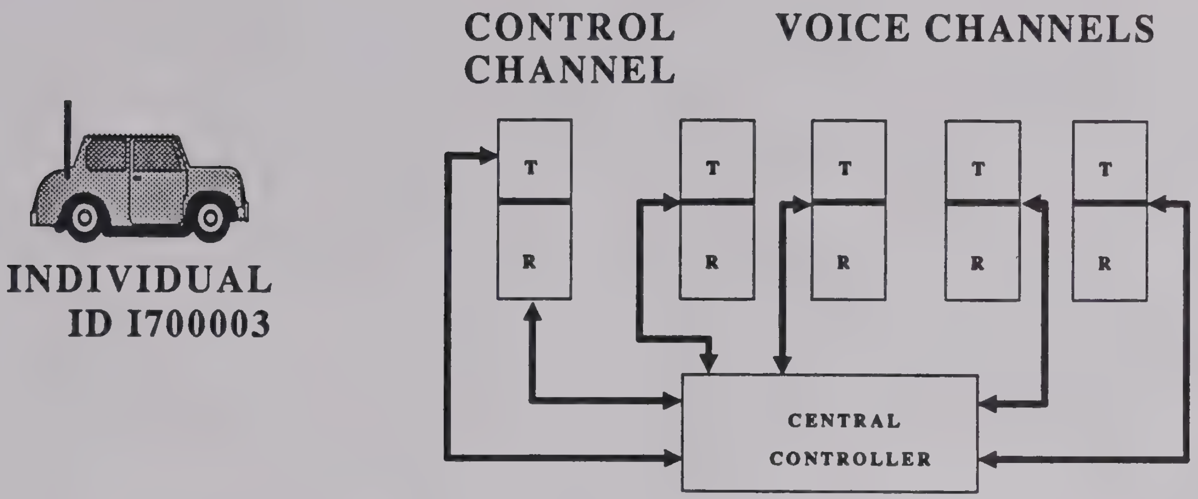
C. Announcement group.

1. A unique 3 digit (hex) number which represents a set of talk groups on a system.

2. The group may contain any number of talk groups. The organizational needs of the customers will determine what talk groups are affiliated with an announcement group. This information will be programmed into the radios to determine which groups they will operate in.

3. The Central has no programmed record of Talk groups to Announcement group affiliation. This data must be entered manually into the Central using the System Managers Terminal for proper call processing to take place.

MOBILE/CENTRAL TALK GROUP AFFILIATION TABLES


CONTROL CHANNEL
VOICE CHANNELS
INDIVIDUAL ID I700003
T
R
T
R
T
R
T
R
T
R
CENTRAL CONTROLLER

RADIO

MODE #	TALK GROUP # HEX	TALK GROUP # DECIMAL
0	001	T800001
1	002	T800002
2	003	T800003
3	004	T800004
4	00B	T800011
5	00C	T800012

CSC

INDIVIDUAL ID #	TALK GROUP TABLE
I700001	T800020
I700002	T800001
I700003	T800011
I700004	T800001
I700005	T800100
I700006	T800001
I700007	T800011
I700008	T800020
I700009	T800300
I700010	T800001
I700011	T800011
I700012	T800001
I700013	T800100
I700014	T800001

Type II individual — dec

Type II talk group — dec

Fig. 1.2.2

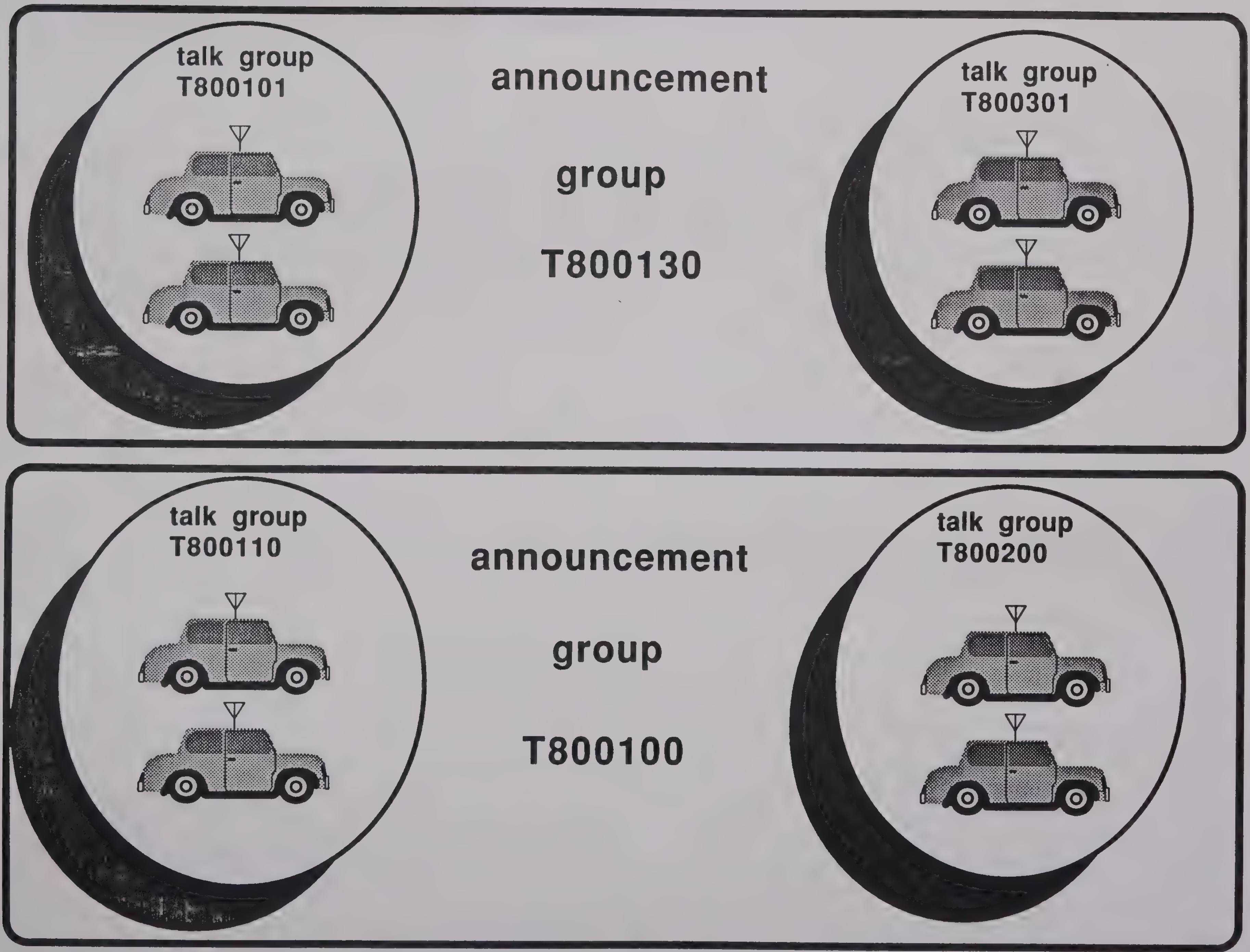

talk group T800101
announcement group T800130
talk group T800301
talk group T800110
announcement group T800100
talk group T800200

Fig. 1.2.3

D. Radio’s Programming

1. The Central Controller does not determine the talk group the unit may operate in, this is done in the programming of the radio.

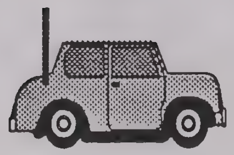
2. The radio will inform the central of the current talk group it is operating in by affiliation.

3. The Affiliation update may be performed by two methods, depending on how the radio was programmed to Affiliate:

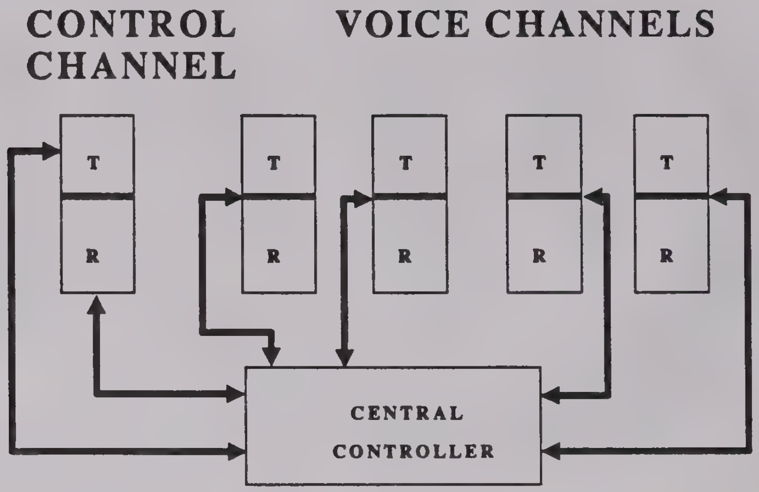
   a. Push-to-talk: The operator changes the talk group it is working in. When the PTT is depressed the radio will send in a dual ISW. The first word contains the Individual ID and call type, the second word contains the updated talk group ID.

   b. Auto: The operator changes the talk group it is currently operating in. A few seconds after the change, the radio will automatically send in an ISW to update the central of the new talk group ID. When the operator depresses it’s PTT it will now only need to send in a single ISW with it’s Individual ID and call type. This will be a faster access time. If the operator depresses it’s PTT prior to time set to send in the new affiliation, the radio will use PTT affiliation to update the Central.

MOBILE/CENTRAL TALK GROUP AFFILIATION TABLES



INDIVIDUAL
ID 0003


CONTROL CHANNEL
VOICE CHANNELS
T
R
T
R
T
R
T
R
T
R
CENTRAL CONTROLLER

RADIO

MODE #	TALK GROUP #
0	0001
1	0002
2	0003
3	0004
4	000B
5	000C

CSC

INDIVIDUAL ID #	TALK GROUP TABLE
0001	0020
0002	0000
0003	000B
0004	0000
0005	0100
0006	0000
0007	000B
0008	0020
0009	0300
0010	0000
0011	000B
0012	0000
0013	0100
0014	0000

Fig. 1.2.2

E. The Central Controller Programming

1. The central is programmed with a static list of individual ID's.

2. A dynamic list of talk group affiliations is initially empty until the radios inform the central of the talk groups that they want to operate in.

3. The central has no pre-programmed listing of relationships between talk groups. These relationships must be entered in manually using the SYSTEM MANAGERS TERMINAL to make talk group to announcement group afiliations.

F. Hybrid system.

1. CSC Type II software:

   a. A memory map with prefixes assigned to type I ID's with Fleet boundaries. Some of the fleets may be mixed fleets that contain both type I and II ID's. This would enable the customer to buy new Type IIi radios with the ability to communicate to the established fleet of type I radios. Prefixes assigned to type II ID's with 8000 per prefix available and no Fleet boundaries.

   b. The ability to do fast access for the type II and IIi radios (no HSHS or Acknowledge tone), as well as slow access for the type I radios (HSHS and Acknowledge tone).

   c. Eight different levels of user priority, #1 reserved for emergency (smartnet only), non-assignable.

   d. Affiliate command, using the system managers terminal, designates Announcement group with it's associated talk groups. The Central needs this information for proper call processing of an Announcement group call request.

e. Multi-group call processing is the way the Central will initiate the fleet or announcement group calls when received. This may take place by one of the two following methods:

1). Interrupt - The Central receives the Multi-group call request (Fleet or Announcement group), checks to see if any talk group associated with it is in an active call. A disconnect word will be sent out on those voice channels with active calls. When the members go back to the Control channel they will decode the Multi-group call channel grant and the call will take place immediately. Those radios transmitting at the time the disconnect was sent, will join the group after they dekey if the call is still active.

2). Wait- The Central receives the Multi-group call request (Fleet or Announcement group), checks to see if any talk groups associated with it is in an active call. A busy acknowledgement will be sent the initiating radio, if there are, and those groups calls will become transmission trunked. When they dekey they will return to the control channel and the initiating radio will get a call back with a voice channel grant.

f. Using the System Managers Terminal - there are four logons with different access abilities depending on the logon used. The ability to steer user groups to selected channels in the system. Affiliation command used to enter the talk group to announcement group affiliation. The ability to back up changes made directly to a disk and then load it back in.

2. Twin Type Radio software.

a. The radio may be programmed to operate as a Type I, Type II, or Type IIi personality.

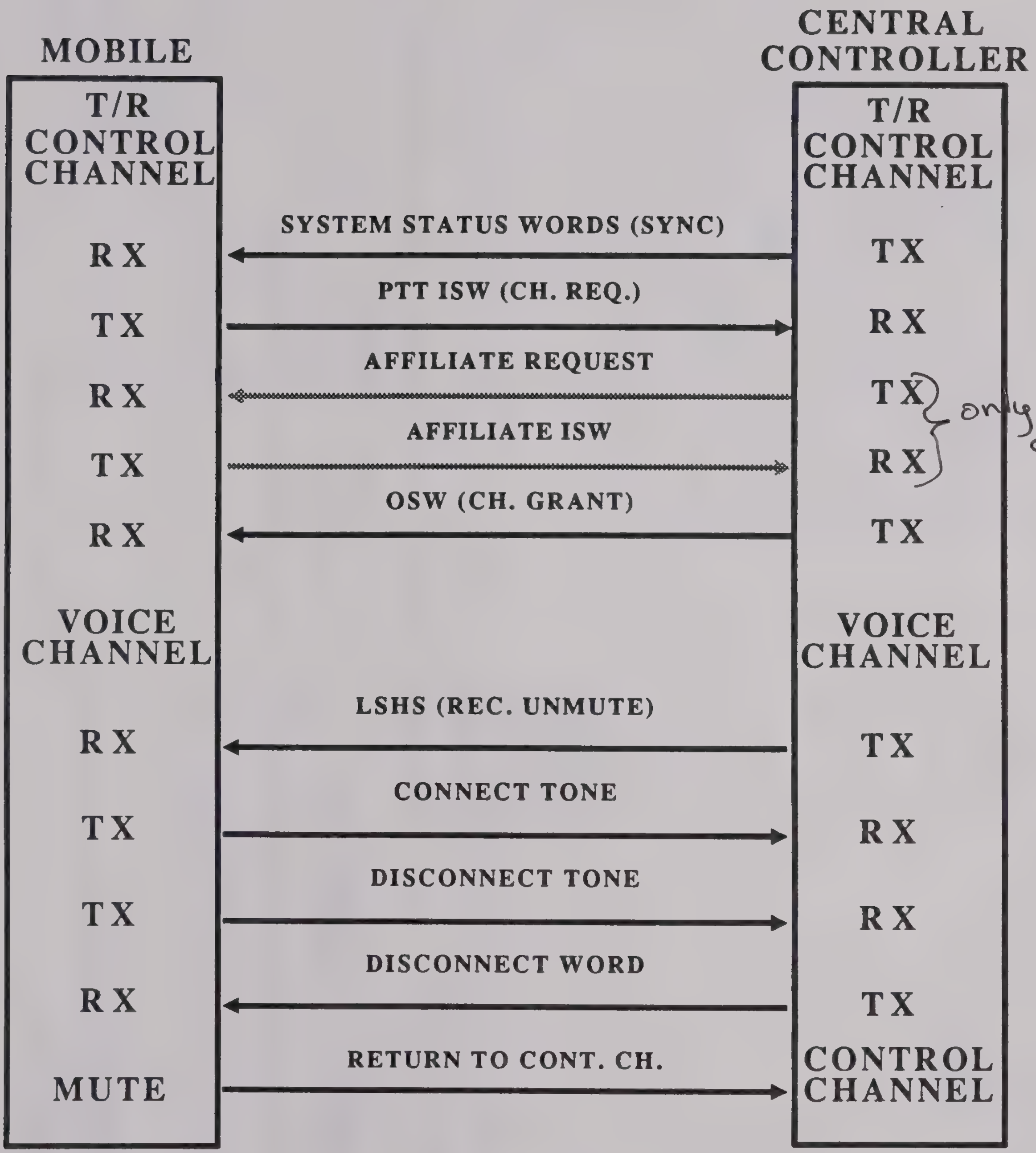
b. The type IIi personality contains both type I and II characteristics such as:

1). Size code, fleet and subfleet ID's

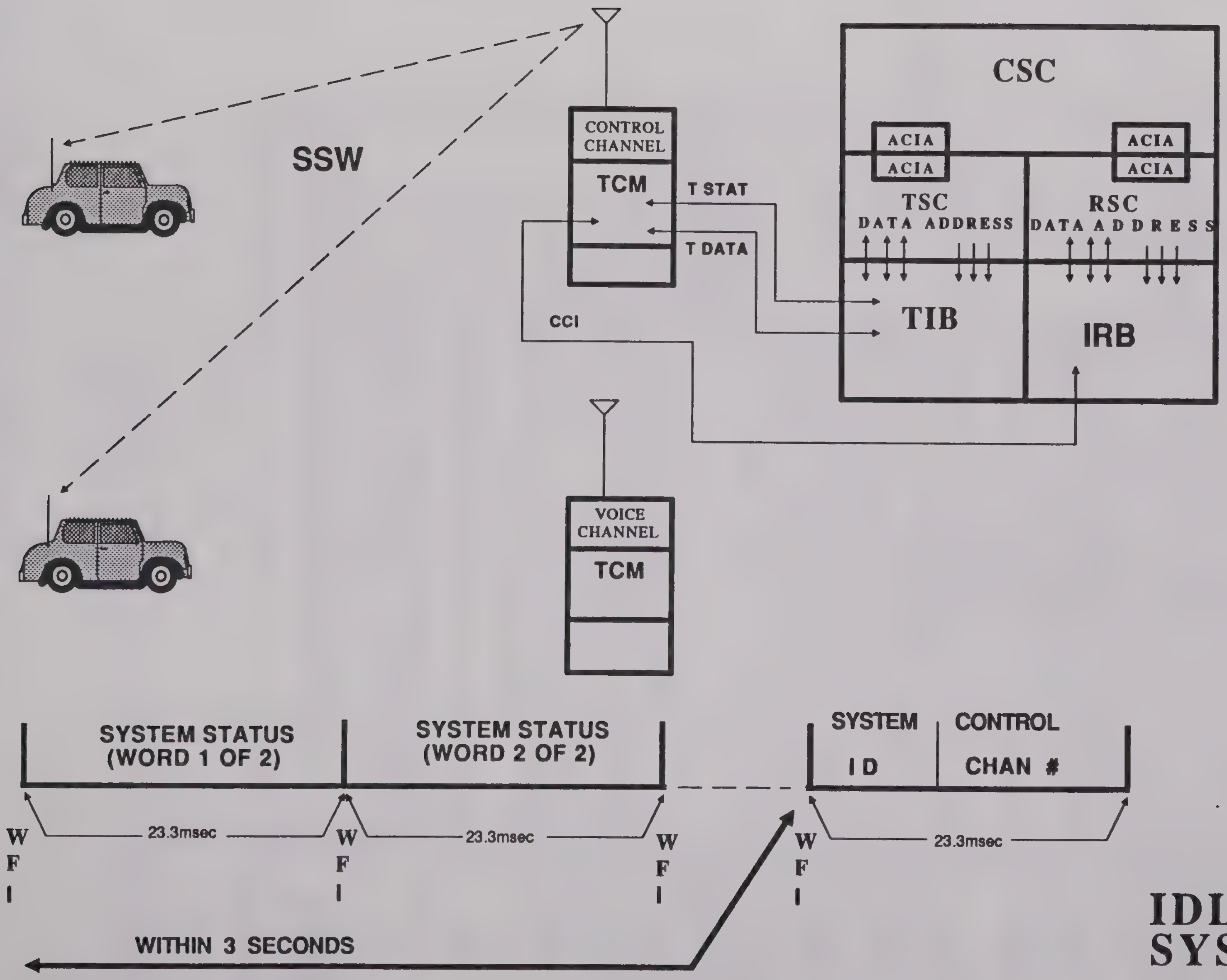
2). Universal ID

3). The radio would have to be programmed with this personality to communicate to both type I and II radio personalities.

TYPE 2 TRUNKED SIGNALING SUMMARY


MOBILE
CENTRAL CONTROLLER
T/R CONTROL CHANNEL
T/R CONTROL CHANNEL
SYSTEM STATUS WORDS (SYNC)
RX
TX
PTT ISW (CH. REQ.)
TX
RX
AFFILIATE REQUEST
RX
TX
AFFILIATE ISW
TX
RX
OSW (CH. GRANT)
RX
TX
VOICE CHANNEL
VOICE CHANNEL
LSHS (REC. UNMUTE)
RX
TX
CONNECT TONE
TX
RX
DISCONNECT TONE
TX
RX
DISCONNECT WORD
RX
TX
RETURN TO CONT. CH.
MUTE
CONTROL CHANNEL

only if no current affiliation


SSW
CONTROL CHANNEL
TCM
T STAT
T DATA
CCI
VOICE CHANNEL
TCM
CSC
ACIA
ACIA
ACIA
ACIA
TSC
DATA ADDRESS
RSC
DATA ADDRESS
TIB
IRB
SYSTEM STATUS (WORD 1 OF 2)
SYSTEM STATUS (WORD 2 OF 2)
SYSTEM ID
CONTROL CHAN #
23.3msec
23.3msec
23.3msec
WFI
WFI
WFI
WFI
WITHIN 3 SECONDS

IDLE SYSTEM

WFI = WORD FRAME INTERRUPT

– – – – – → SYSTEM STATUS WORDS

Fig. 1.2.4

II. TYPE II SIGNALLING

A. Idle System

1. Scans for control channel

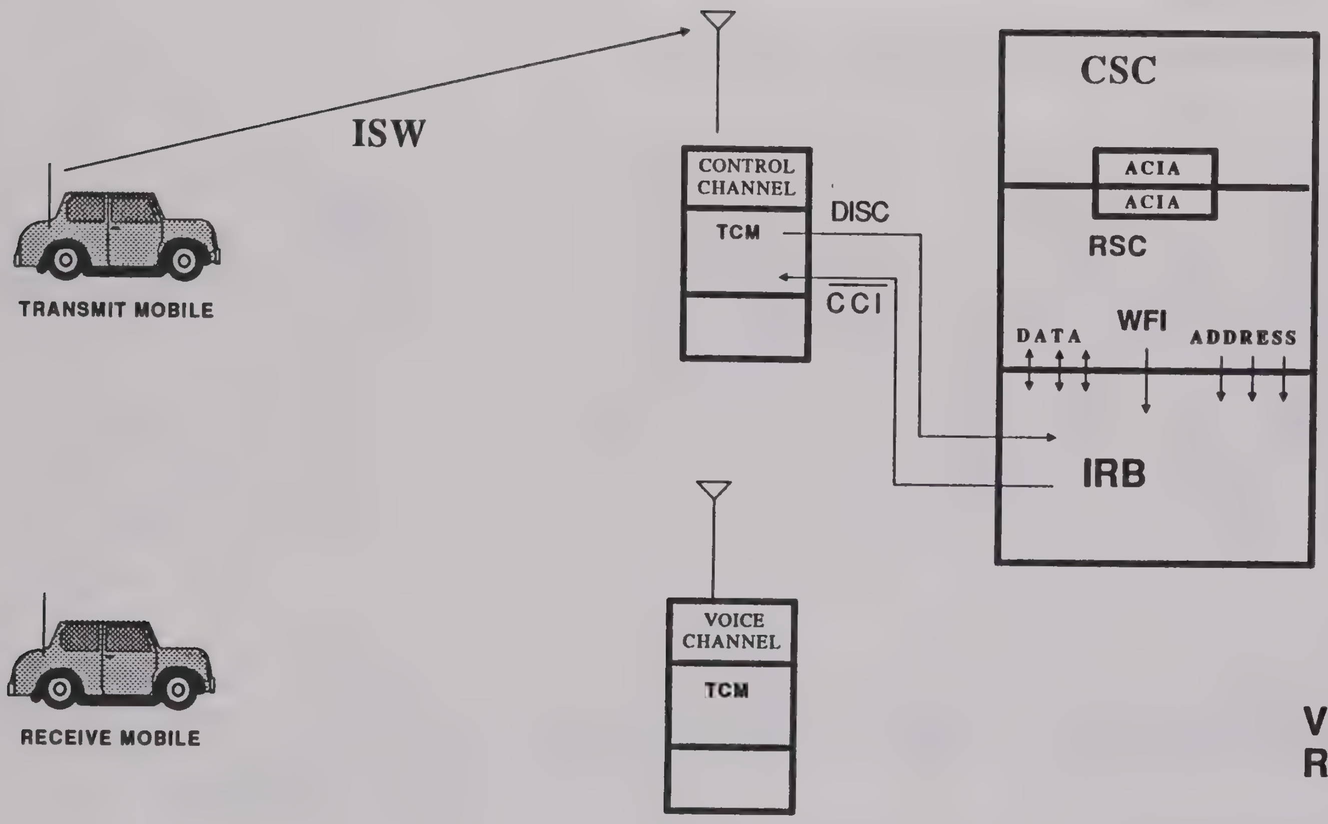
2. When System ID is found, the unit will monitor background data consisting of dual word system status information, (used for bit and word synchronization).

3. Once locked on control channel, mobile watches and decodes.

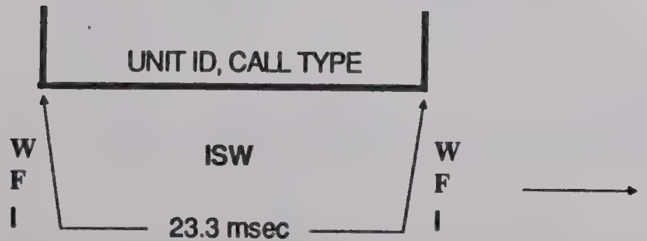
    a. System ID sent at least every 3 seconds
    b. Control channel data

4. If system ID and control channel frequency are not available, the unit will continue to scan.

5. Mic PTT - mobile polls PTT every 23 mSecs to see if depressed.


ISW
TRANSMIT MOBILE
RECEIVE MOBILE
CONTROL CHANNEL
TCM
DISC
$\overline{CCI}$
VOICE CHANNEL
TCM
CSC
ACIA
ACIA
RSC
DATA
WFI
ADDRESS
IRB

VOICE CHANNEL REQUEST

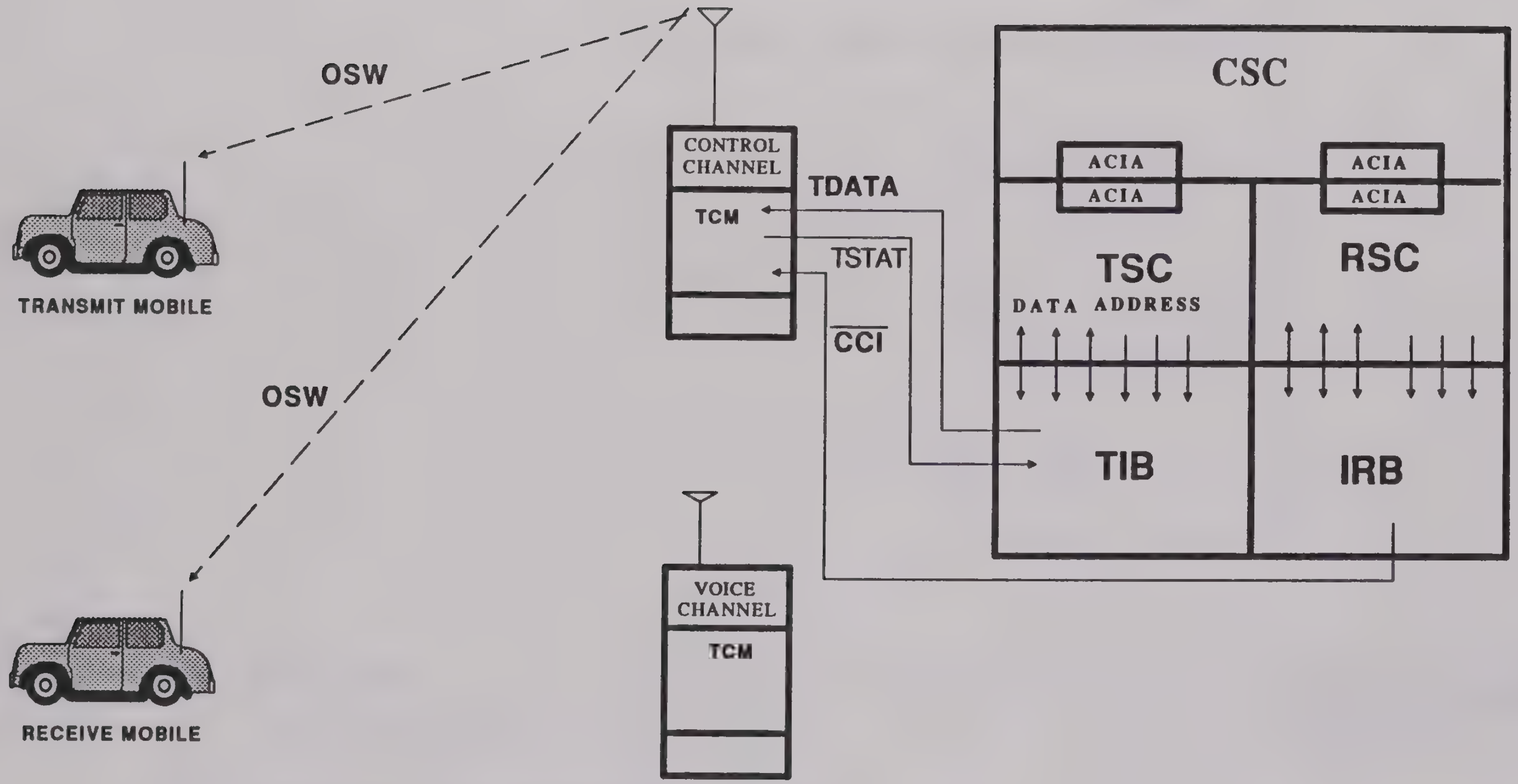

UNIT ID, CALL TYPE
W F I
ISW
W F I
23.3 msec

I S W (SERVICE REQUEST)

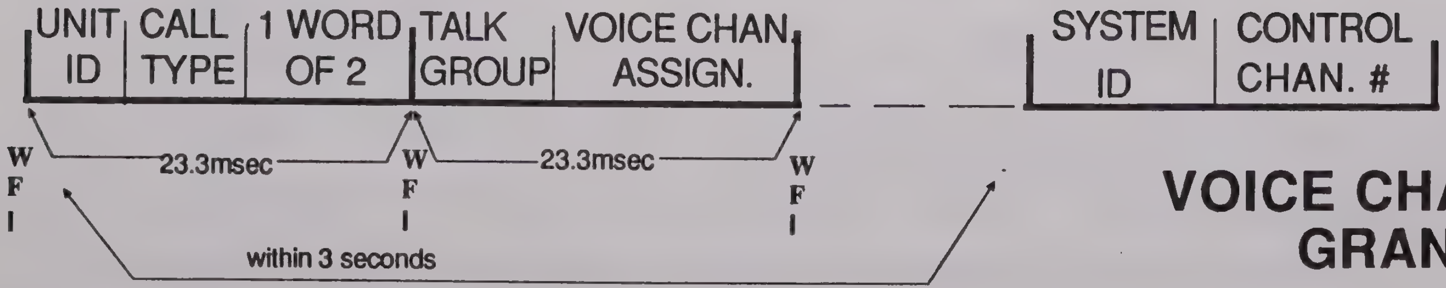
Fig. 1.2.5

B. **Voice Channel Request**

1. Sends Inbound Signaling Word (ISW) to request a voice channel.
2. ISW contains: 1) Unit ID (2) type call - group, system, individual.
3. Inserted in queue by central controller. If unit is not already affiliated, the Central Controller will send an affiliate request OSW. Mobile will perform 4.
4. The portable/mobile will send a dual ISW containing: 1) Unit ID and call type, 2) update talk group ID.
5. Depending upon call type, may be one of several priority levels.
    a. System/Announcement group calls
    b. Recent system users
    c. New users


OSW
OSW
TRANSMIT MOBILE
RECEIVE MOBILE
CONTROL CHANNEL
TCM
TDATA
TSTAT
$\overline{\text{CCI}}$
VOICE CHANNEL
TCM
CSC
ACIA
ACIA
ACIA
ACIA
TSC
DATA ADDRESS
RSC
TIB
IRB

- - - → OSW (VOICE CHANNEL ASSIGNMENT) SENT 4 TIMES IN A ROW, IN DUAL WORD FORMAT


UNIT ID
CALL TYPE
1 WORD OF 2
TALK GROUP
VOICE CHAN ASSIGN.
SYSTEM ID
CONTROL CHAN. #
WFI
23.3msec
WFI
23.3msec
WFI
within 3 seconds

VOICE CHANNEL GRANT

Fig. 1.2.6

C. **Channel Grant Outbound Signaling Word**

1. Central controller sends Channel Grant (OSW) via control channel to the mobile. Sent four times in rapid succession in dual word format.

2. OSW contains:

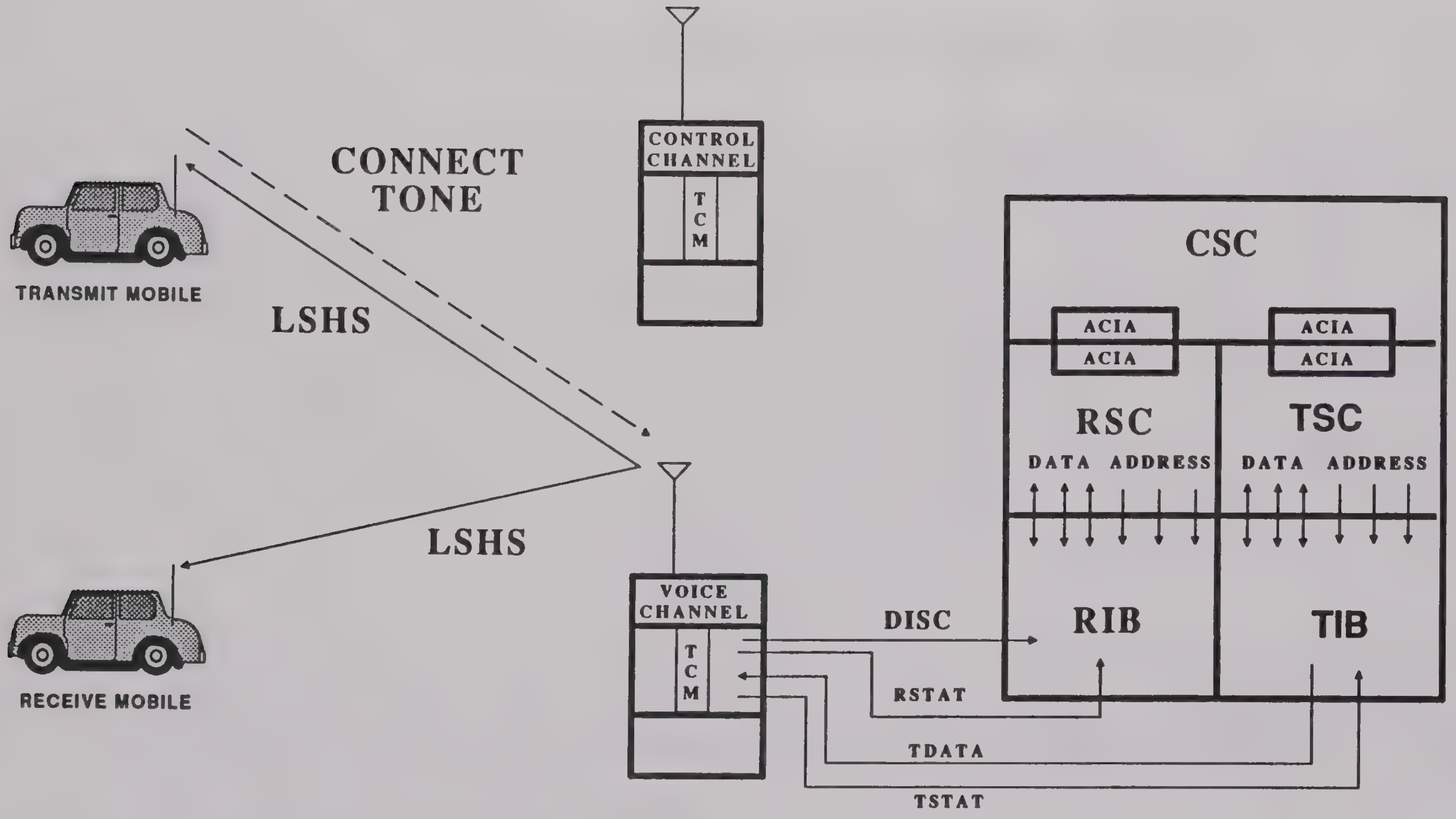
   a. Individual ID of requesting unit

   b. The group or talkgroup which is to be sent to the channel to receive.

   c. Type of call - group, system, individual.

   d. Voice channel assignment

3. Repeated randomly during radio conversation to update new mobiles. Update OSW's sent in a single word format. (Continuous assignment updating.)


CONNECT TONE
TRANSMIT MOBILE
LSHS
CONTROL CHANNEL
T C M
CSC
ACIA
ACIA
ACIA
ACIA
RSC
TSC
DATA ADDRESS
DATA ADDRESS
LSHS
RECEIVE MOBILE
VOICE CHANNEL
T C M
DISC
RIB
TIB
RSTAT
TDATA
TSTAT

CONNECT TONE

——→ LOW SPEED HANDSHAKE (LSHS)

- - - - - → CONNECT TONE
(105.88 Hz or SP)

Fig. 1.2.7

D. Connect Tone

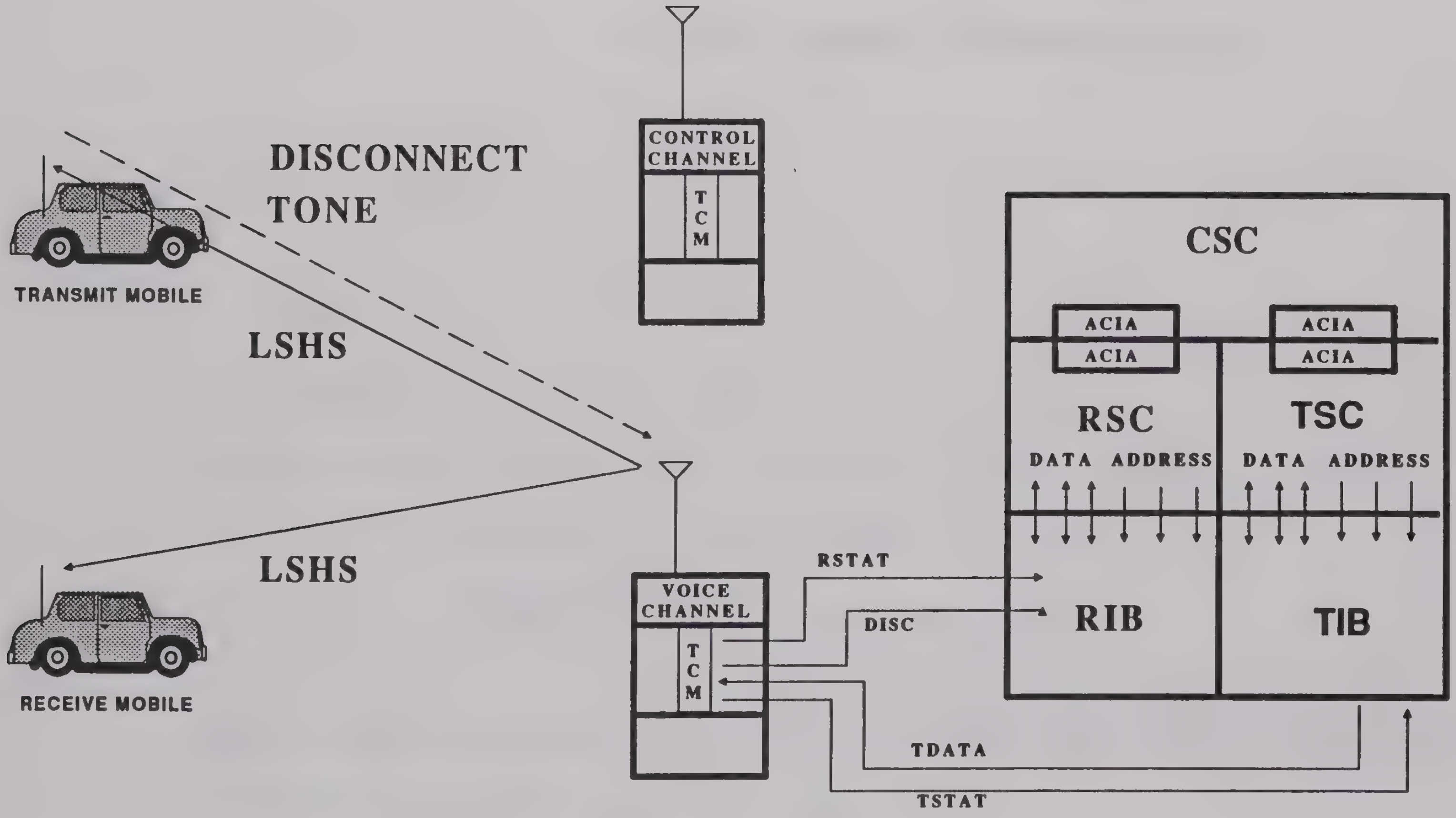
1. Mobile microphone is un-muted and voice transmission can begin.
2. Mobile transmits sub-audible Connect Tone (105.88 Hz) at low deviation, which is recognized by central controller to keep the channel connected and unmute the repeater.
3. Other Connect Tone frequency options: 76.7 Hz, 83.7 Hz, 90.0 Hz, 97.3 Hz, 128.5 Hz, 138.46 Hz.

LSHS (Connect Word)

1. Low speed handshake, sent at 150 baud.
2. Used to unmute received audio and to hold receiving radios on assigned voice channel. To stay on voice channel, must continue to detect LSHS data.

LSHS $\boxed{\text{TG}}$ Specific bits of OSW (@150 baud) sent from central.

3. Receive radio will unmute after receiving two LSHS's.
4. To stay on voice channel, must continue to detect LSHS data words.
5. If not detected, radio will return to control channel.



DISCONNECT TONE
TRANSMIT MOBILE
LSHS
LSHS
RECEIVE MOBILE
CONTROL CHANNEL
T C M
VOICE CHANNEL
T C M
RSTAT
DISC
TDATA
TSTAT
CSC
ACIA
ACIA
ACIA
ACIA
RSC
TSC
DATA ADDRESS
DATA ADDRESS
RIB
TIB

DISCONNECT TONE

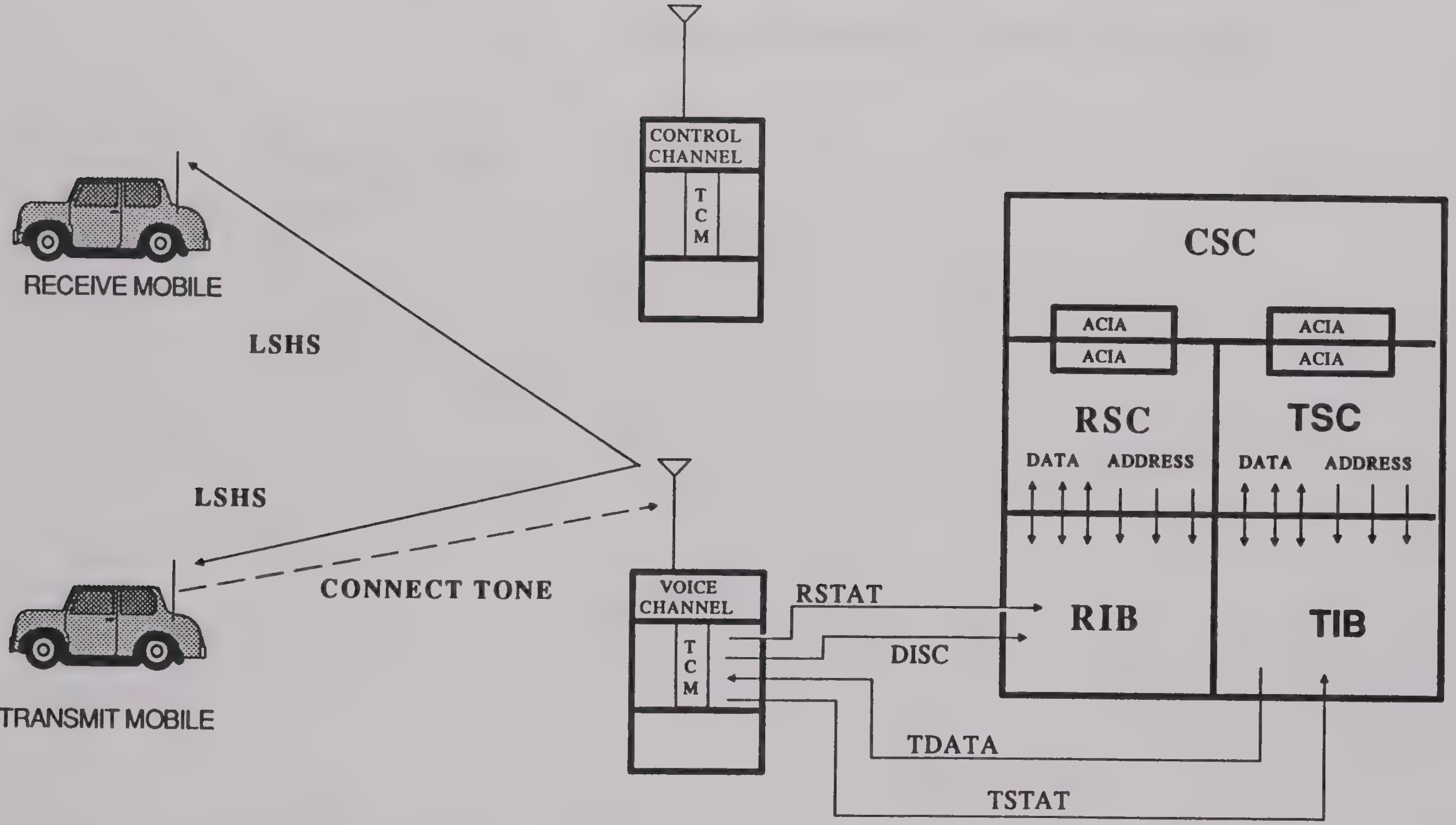
——→ LOW SPEED HANDSHAKE (LSHS)

- - - - - - → DISCONNECT TONE
(163.64 Hz, 200 mSECONDS)

Fig. 1.2.8

E. END OF TRANSMISSION

1. Release of PTT.
2. Mobile sends 200 mSec of Disconnect Tone.
3. 163.64 Hz at 750 Hz deviation.
4. In message trunking, the Central Controller detects the Disconnect Tone and begins a message time-out timer (typically 0-6 seconds, factory default set for 1 Sec.).
5. Transmitting unit switches to receive mode and unmutes after detecting LSHS.


CONTROL CHANNEL
TCM
RECEIVE MOBILE
LSHS
LSHS
CONNECT TONE
TRANSMIT MOBILE
VOICE CHANNEL
TCM
CSC
ACIA
ACIA
ACIA
ACIA
RSC
TSC
DATA
ADDRESS
DATA
ADDRESS
RSTAT
DISC
RIB
TIB
TDATA
TSTAT

CALL CONTINUATION

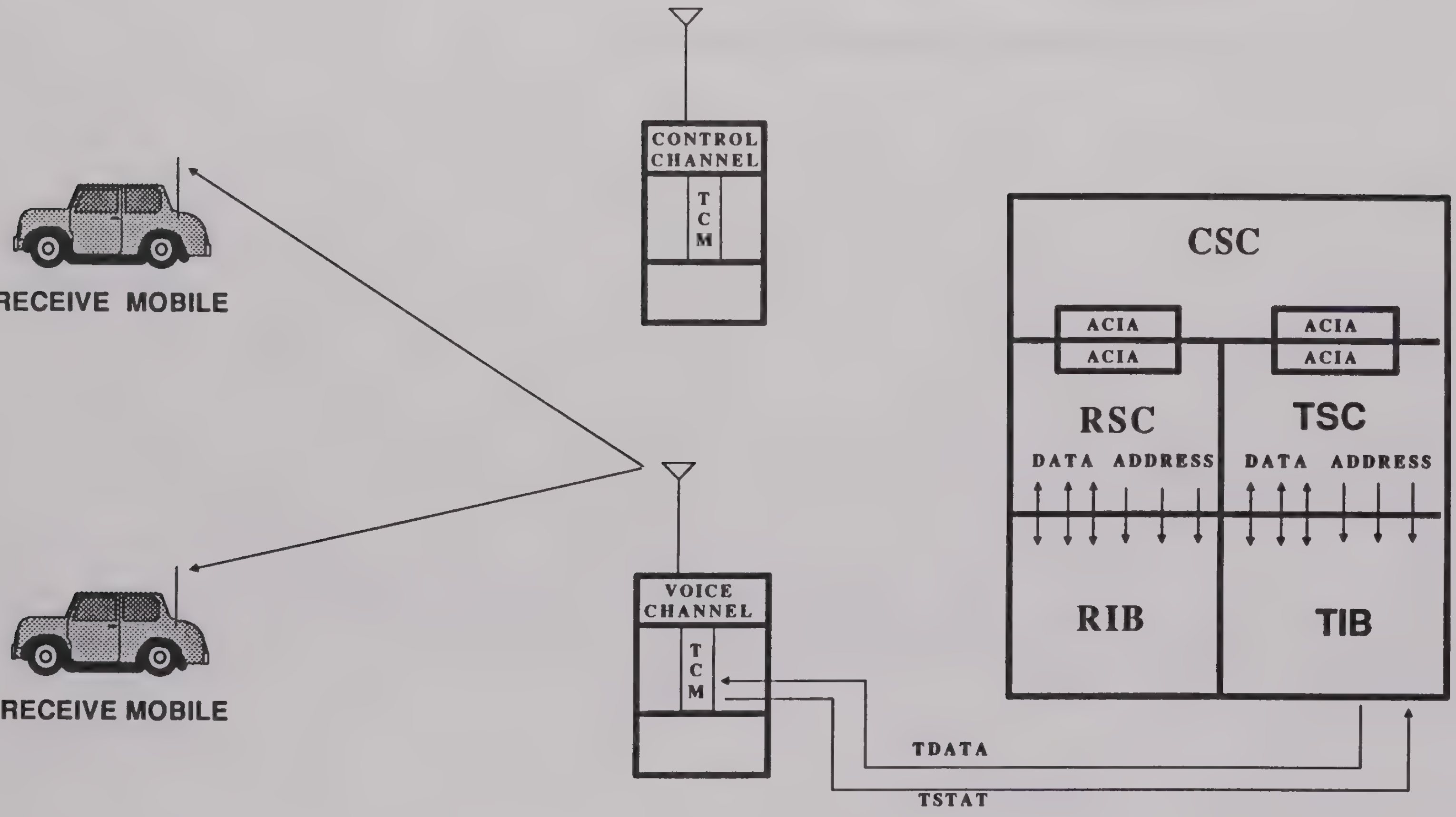
——→ LOW SPEED HANDSHAKE (LSHS)

- - - - → CONNECT TONE
(105.88 Hz or SP)

Fig. 1.2.9

F. Call Continuation

1. Any other receiving radio on the same voice channel may respond to the original transmitting radio by pressing PTT and sending a connect tone plus voice. (Message Trunking)
2. Central controller will detect connect tone and reset message time-out timer.


RECEIVE MOBILE
RECEIVE MOBILE
CONTROL CHANNEL
TCM
VOICE CHANNEL
TCM
TDATA
TSTAT
CSC
ACIA
ACIA
ACIA
ACIA
RSC
DATA ADDRESS
TSC
DATA ADDRESS
RIB
TIB

DISCONNECT WORD

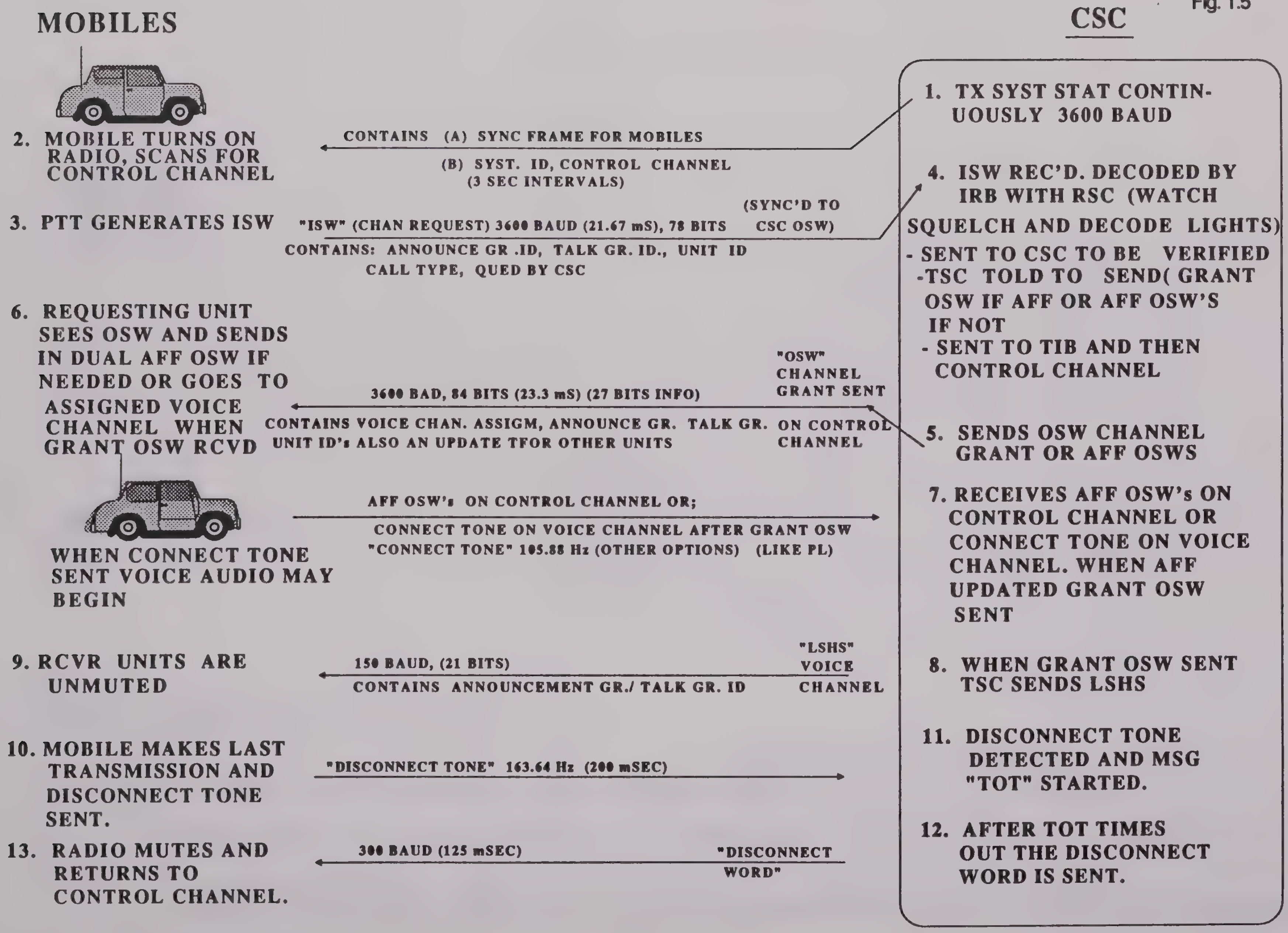
→ DISCONNECT WORD
(125 mSECONDS, 300 BAUD)

Fig. 1.3.0

G. Disconnect Word

1. Central Controller disconnects radios by sending 125 mSec of low speed Disconnect Word (300 Baud at 1 KHz deviation).
2. Radios mute and return to control channel when disconnect word is detected.
3. Channel becomes available for re-assignment.

Fig. 1.5



MOBILES

CSC

1. TX SYST STAT CONTINUOUSLY 3600 BAUD

CONTAINS (A) SYNC FRAME FOR MOBILES
(B) SYST. ID, CONTROL CHANNEL
(3 SEC INTERVALS)

2. MOBILE TURNS ON RADIO, SCANS FOR CONTROL CHANNEL

3. PTT GENERATES ISW

"ISW" (CHAN REQUEST) 3600 BAUD (21.67 mS), 78 BITS (SYNC'D TO CSC OSW)
CONTAINS: ANNOUNCE GR .ID, TALK GR. ID., UNIT ID
CALL TYPE, QUED BY CSC

4. ISW REC'D. DECODED BY IRB WITH RSC (WATCH SQUELCH AND DECODE LIGHTS)
- SENT TO CSC TO BE VERIFIED
-TSC TOLD TO SEND(GRANT OSW IF AFF OR AFF OSW'S IF NOT
- SENT TO TIB AND THEN CONTROL CHANNEL

5. SENDS OSW CHANNEL GRANT OR AFF OSWS

"OSW" CHANNEL GRANT SENT ON CONTROL CHANNEL
3600 BAD, 84 BITS (23.3 mS) (27 BITS INFO)
CONTAINS VOICE CHAN. ASSIGM, ANNOUNCE GR. TALK GR.
UNIT ID's ALSO AN UPDATE TFOR OTHER UNITS

6. REQUESTING UNIT SEES OSW AND SENDS IN DUAL AFF OSW IF NEEDED OR GOES TO ASSIGNED VOICE CHANNEL WHEN GRANT OSW RCVD

AFF OSW's ON CONTROL CHANNEL OR;
CONNECT TONE ON VOICE CHANNEL AFTER GRANT OSW
"CONNECT TONE" 105.88 Hz (OTHER OPTIONS) (LIKE PL)

WHEN CONNECT TONE SENT VOICE AUDIO MAY BEGIN

7. RECEIVES AFF OSW's ON CONTROL CHANNEL OR CONNECT TONE ON VOICE CHANNEL. WHEN AFF UPDATED GRANT OSW SENT

8. WHEN GRANT OSW SENT TSC SENDS LSHS

"LSHS" VOICE CHANNEL
150 BAUD, (21 BITS)
CONTAINS ANNOUNCEMENT GR./ TALK GR. ID

9. RCVR UNITS ARE UNMUTED

10. MOBILE MAKES LAST TRANSMISSION AND DISCONNECT TONE SENT.

"DISCONNECT TONE" 163.64 Hz (200 mSEC)

11. DISCONNECT TONE DETECTED AND MSG "TOT" STARTED.

12. AFTER TOT TIMES OUT THE DISCONNECT WORD IS SENT.

"DISCONNECT WORD"
300 BAUD (125 mSEC)

13. RADIO MUTES AND RETURNS TO CONTROL CHANNEL.

Trunk System Signaling

(FIXED-END)

CONTROL CHANNEL - TRANSMIT

1. System Status (Background data) words at 3600 baud
2. Outbound signaling word at 3600 baud
3. System ID (at least) every 3 seconds

CONTROL CHANNEL - RECEIVE

1. Inbound signaling word at 3600 baud

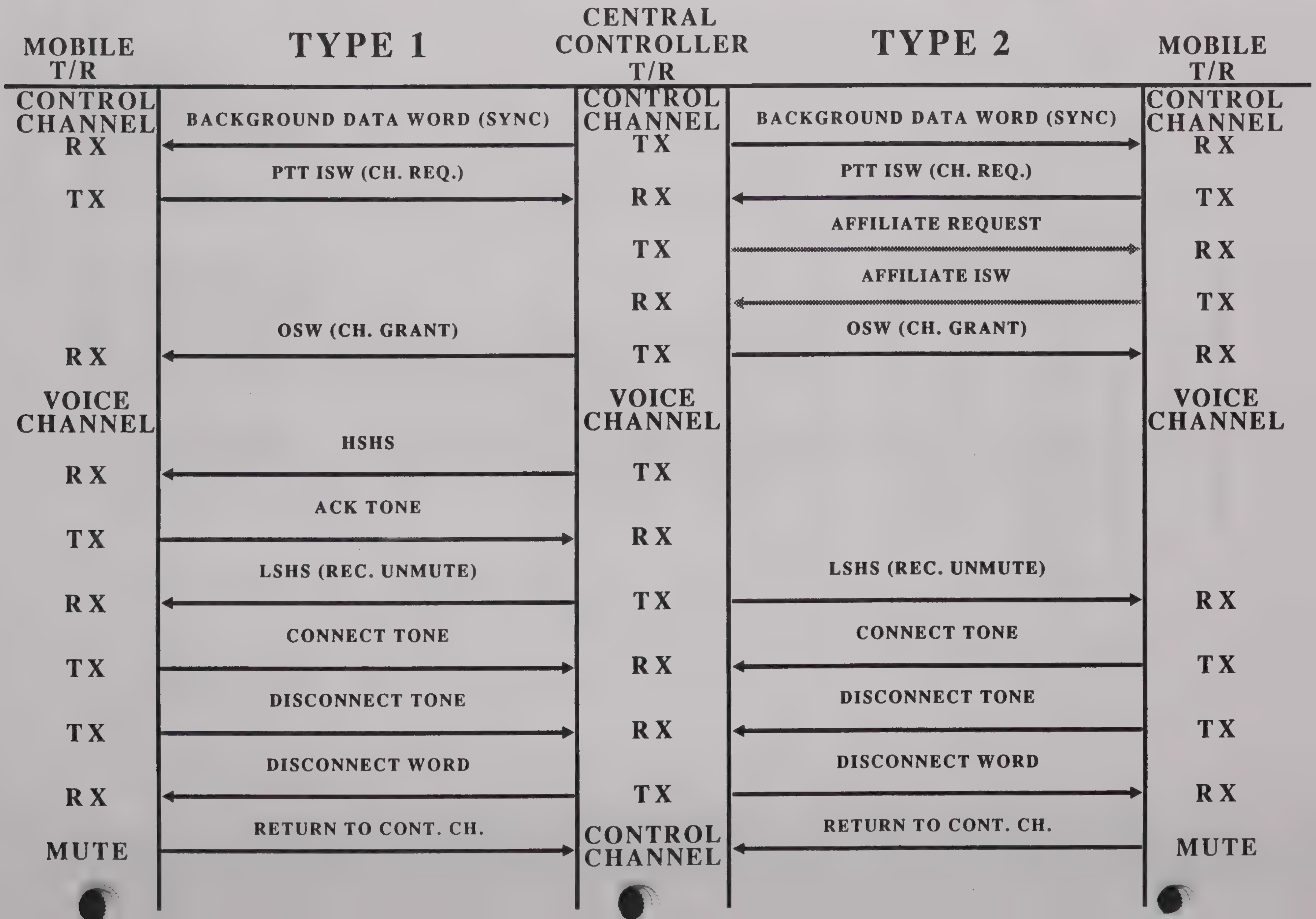
VOICE CHANNEL - TRANSMIT

1. Connect word/low speed handshake at 150 baud.
2. Disconnect word at 300 baud
3. Failsoft at 150 Hz
4. Normal voice communications

VOICE CHANNEL - RECEIVE

1. Connect tone at 105 Hz (SP)
2. Disconnect tone at 163 Hz
3. Normal voice communications

TRUNKED SIGNALING SUMMARY



MOBILE T/R	TYPE 1	CENTRAL CONTROLLER T/R	TYPE 2	MOBILE T/R
CONTROL CHANNEL RX	← BACKGROUND DATA WORD (SYNC)	CONTROL CHANNEL TX	BACKGROUND DATA WORD (SYNC) →	CONTROL CHANNEL RX
TX	PTT ISW (CH. REQ.) →	RX	← PTT ISW (CH. REQ.)	TX
		TX	AFFILIATE REQUEST →	RX
		RX	← AFFILIATE ISW	TX
RX	← OSW (CH. GRANT)	TX	OSW (CH. GRANT) →	RX
VOICE CHANNEL		VOICE CHANNEL		VOICE CHANNEL
RX	← HSHS	TX		
TX	ACK TONE →	RX		
RX	← LSHS (REC. UNMUTE)	TX	LSHS (REC. UNMUTE) →	RX
TX	CONNECT TONE →	RX	← CONNECT TONE	TX
TX	DISCONNECT TONE →	RX	← DISCONNECT TONE	TX
RX	← DISCONNECT WORD	TX	DISCONNECT WORD →	RX
MUTE	RETURN TO CONT. CH. →	CONTROL CHANNEL	← RETURN TO CONT. CH.	MUTE

OPTIONS

ADDITIONAL CALL TYPES

AND

OPTIONAL PERIPHERALS

I. Additional Call Types

A. Private Conversation

1. Private Conversation One, PC I.

   a). PC I has the capability to talk in the private mode to units with PC within his fleet only.

   b). A supervisor's unit can call up to 8 non-supervisor units per personality.

   c). A non-supervisor's unit can call one predetermined unit, his supervisor and may also be selected to receive PC only.

   d). The target unit will be alerted by two beeps or unit display and two beeps.

   e). Once the call is established, the two units will not hear other call traffic.

   f). Once the private conversation is over, the units will have to switch from the private mode to hear normal call traffic.

Limitations:

All supervisors have the same ID therefore:

a). There are no "Supervisor" to "Supervisor" call capabilities.

b). There is no guarantee that you will have totally private conversation. A party call will exist between supervisor and non-supervisor due to the fact that all supervisors have the same pool ID.

c). When multiple supervisors have different pool ID's: They cannot contact or be contacted outside of their supervisor unit pool ID.

NOTE: PC I available only on TYPE I systems.

2). Private Conversation Two, PC II

A. Private Conversation (continued)

a). PC II, has the capability to cross fleet boundaries.

b). With PC II, an unlimited number of units can be called by unit ID as long as those units are PC and are programmed into the transmitting unit.

c). All supervisors have their own individual ID's, calls can be made between them.

d). There is a dual ISW sent out that prevents party line calls from occurring.

e). All "Supervisor" have access to all "Non-supervisor" and vice-versa with the exception that non-supervisors may be limited to receive only.

3). Private Conversation Unlimited

a). Unlimited has the capability to call an unlimited amount of units by punching in that unit's ID.

b). The target unit has to have the private call option.

B. Call alert

1. General

a. Allows a dispatcher or radio user to selectively alert an individual.

b. From a Centracom console, the dispatcher can Call Alert any call alert unit. Call Alert can also be sent from Smartnet Interface Management System (SIMS) and Smartnet Information Processors (SIP).

c. To initiate a Call Alert, the dispatcher or radio operator switches to the Call Alert mode and selects the unit to be called.

B. Call Alert (continued)

   d. The alert is sent by depressing the PTT which will produce an audible or visual alert on the receive unit.

   e. The alert indicators will stop when the receive unit depresses his PTT.

   f. The initiating unit will be notified that the receive unit has received the alert by the indicators on his unit.

2. Call Alert I

   There are four types of Call Alerts available for mobiles and portables:

   a. Decode only (can receive a call but cannot initiate a call).

   b. Single encode (a unit can call alert one predetermined unit).

   c. Multiple encode (a unit can call alert up to eight predetermined units).

   d. Unlimited (a unit can call alert any unit in his fleet that is call alert capable).

   NOTE: Unlimited can cross fleet boundaries.

3. Call Alert II

   a. The receiving unit will display and store the calling unit's ID.

   b. This is done by a dual word message that is sent out which identifies the caller and receiver.

   NOTE: Call Alert II is not supported by Type I software.

C. Emergency Call (SMARTNET SYSTEMS ONLY)

1. What is Emergency Call

   a. For handling a life-threatening situation, an emergency call capability enables the dispatcher or mobile to have immediate access to a voice channel, even when the system is busy. An emergency call is initiated by a mobile, portable, or dispatcher by depressing an emergency call button.

   b. Whenever an emergency call is initiated from a mobile or portable radio, an audible and visual alarm immediately alerts the dispatcher of an incoming emergency call.

   c. The calling unit ID is flashed on a display indicating which operator is in trouble.

   d. This alarm and unit ID display will occur immediately, even if there is contention on the assigned emergency channel. This is so because the ID and emergency call alert are sent on the control channel as the emergency call request is placed.

   NOTE: SPECIAL EMERGENCY CALL PRIORITY IS ONLY NECESSARY WHEN THE SYSTEM IS COMPLETELY BUSY.

2. Emergency Call Alternatives

   a. Assign available channel.

   b. If none available

      1). Assign reserved emergency channel

      2). If there is no reserved emergency channel.One of the following options :

         a). RUTHLESS PRE-EMPTION

            (1). Emergency caller & new subfleet shares repeater with current user.

            (2). Current user drops off when un-keys.

b). SPECIAL QUEUING

(1). Repeaters become transmission trunked. Emergency call receives first available repeater.

3. Reserved Emergency Channel

   a. One alternative is to specify one or more reserved repeater channels to be used exclusively for emergency traffic.

   b. If this method is used and an additional emergency occurs for which there is no reserved channel, the system would automatically revert to one of the previously described alternatives.

   c. With this approach, when an emergency call button is depressed, the call will be directed to a reserved channel where all the other pre-designated units for the emergency call group will also be directed.

4. Ruthless Pre-emption

   a. Voice channel immediately assigned.

      1). When an "emergency" button is depressed on a radio, a repeater currently in use is assigned to the emergency calling unit (the central controller will select the lowest priority user currently on a repeater).

   b. Current users on voice channel given immediate disconnect.

      1). Once assigned, all units in the non-emergency fleet on the repeater are returned to the control channel except the transmitting unit which the emergency calling unit can hear.

C. Emergency Call (continued)

2). All units in the emergency call group will now be listening on the "emergency" repeater also. The emergency calling unit can begin to transmit immediately in an attempt to "talk over" the non-emergency unit.

3). In such cases, the listening units in the emergency group may hear either or both transmissions, depending upon RF capture.

c. RF contention occurs with previous user still pushing PTT.

1). As soon as the non-emergency unit un-keys, he will be dropped from that "emergency" repeater and the channel will be assigned exclusively to the emergency traffic users.

2). Once the transmitting mobile un-keys, the channel belongs to the emergency caller.

3). If the originating user has waited for this to occur, he can now transmit with complete assurance of being heard by the other units in his/her emergency group.

NOTE:THE KEY ADVANTAGE OF **RUTHLESS PREEMPTION** IS THAT ALTHOUGH THERE IS CONTENTION FOR USAGE OF A CHANNEL, ACCESS IS IMMEDIATE.

4). Even with all channels busy, the dispatcher will immediately receive an audible alarm sent via the control channel if another emergency call is initiated.

C. Emergency Call (continued)

5. Top-Of-Queue Priority

   a. System changed to transmission trunked

      1). For immediate access during busy periods, all repeaters in the system can automatically become temporarily transmission trunked (zero drop-out time) and give the emergency caller top priority in the queue.

   b. As soon as any user on any voice channel unkeys, emergency call is assigned.

      1). As soon as any transmitting unit unkeys, its channel will be taken away and given to the emergency caller, giving him/her a clear channel in an extremely short period of time (the rest of the repeaters then resume operating with a normal drop-out delay).

   c. NO RF CONTENTION, CLEAR CHANNEL GUARANTEE

6. Capabilities

IN ALL OF THE PRECEDING ALTERNATIVES THE FOLLOWING OPERATIONAL CAPABILITIES ARE PROVIDED:

   a. Once an emergency call is initiated, an extended repeater drop-out time (30 seconds) will minimize the need for re-initiating another emergency call.

   b. At the dispatcher's discretion, a repeater may be manually locked in the emergency mode so that the "emergency repeater" is temporarily reserved for the ensuing emergency traffic regardless of the length of pauses between the messages.

   c. There may be as many simultaneous emergency calls handled as there are voice channels in the system.

C. Emergency Call (continued)

d. When an emergency call is made by a unit, his dispatcher or his whole subfleet group of individuals will automatically join the emergency caller on the assigned emergency repeater just as they will on a normal subfleet call. An "officer down" call could thus automatically be heard by all the members of the officers subfleet who are in a position to help.

e. Emergency alarm - allows a portable or mobile operator to immediately alert the dispatcher of an emergency situation. This is data transmission exchange on the control channel only. A properly equipped dispatcher location must be set up to log emergency alarms.

D. Telephone Interconnect

1. Description - The Central Interconnect Terminal (CIT) extends the communications ability of a trunked radio system without changing the use of the system. Mobile or portable radios that are equipped to generate touch-tone compatible signals (DTMF signals), can automatically access the public service telephone system without the aid of the dispatcher. Land-line users who have been given an access code can call into the radio system from the telephone system.

2. Telco lines - The CIT processes, both land and mobile, initiated telephone interconnect calls, routing as many as 30 incoming TELCO lines to any one of the repeaters on a trunked system. The incoming TELCO lines form a shared base, allowing them to be used by a large number of telephone interconnect subscribers.

3. Dialing options - The CIT operates with either DTMF dial or pulse dial telephone exchanges. The DTMF dial equipped land-line user requires no additional equipment to originate calls through the CIT. The pulse dial user requires an external DTMF dialing device in order to use the CIT after calling in with a pulse dial telephone.

4. Privacy - Individual or group calls are totally private, with no one but the intended party(ies) hearing the conversation. With current mobiles, the voice link established is repeater duplex, mobile simplex. Both individual and subfleet telephone interconnect calls can be serviced by the CIT.

5. Call routing - The routing of a TELCO line to the repeaters is accomplished in the CIT using a microprocessor controlled Crosspoint Matrix, under the direction of the trunking Central Controller.

D. Telephone Interconnect (continued)

6. Mobile Operational Considerations

   a. The amount of time he will be allowed for his call may vary depending on how busy the system is when he places his call. (Shared Service Algorithm)

   b. When his radio is in the phone mode, he will not be able to hear fleet or subfleet calls from his dispatch system.

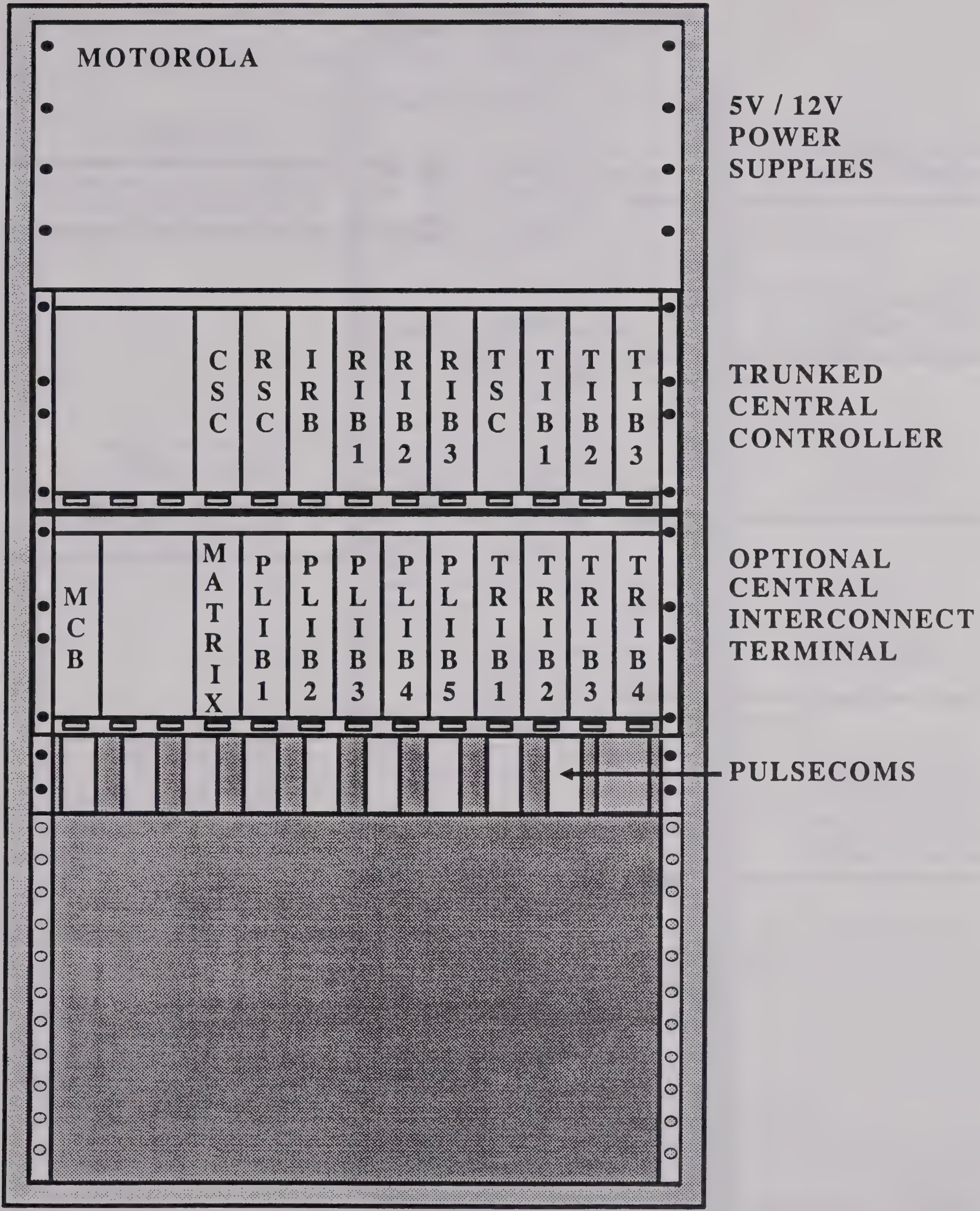
   c. If he is waiting in the interconnect queue, his mobile will be able to receive and acknowledge call alerts signaled on the control channel.

   d. If he leaves his mobile in the phone mode after a call is completed, he will continue to miss all normal dispatch traffic in his fleet, except control channel call alerts.

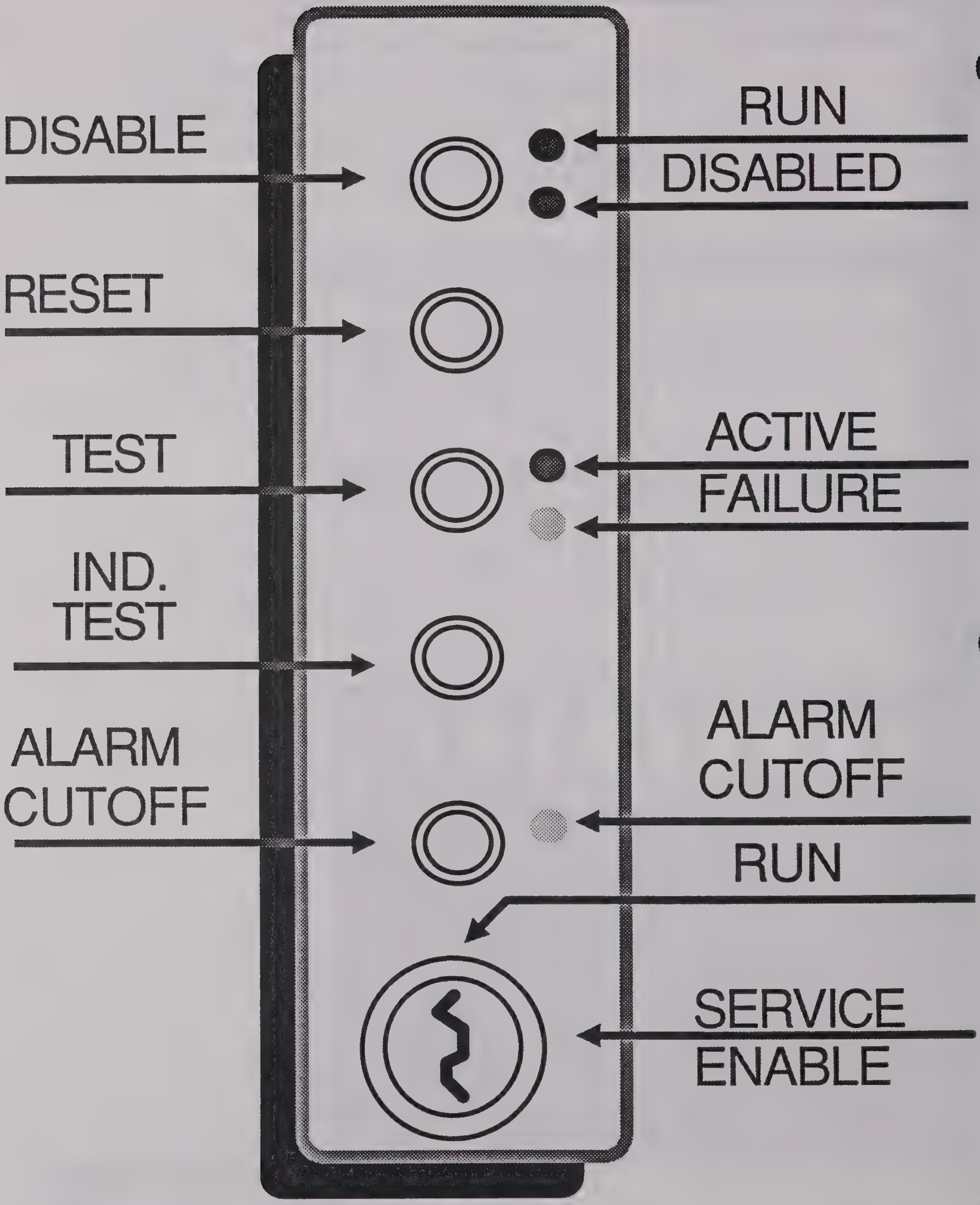
   e. If he attempts to key up in this situation, he will receive a steady tone from his radio indicating he forgot to switch back to dispatch mode.

   f. If an operator wishes to make successive phone calls, he must switch back to dispatch mode and re-initiate his interconnect request for each additional call.

   g. If the land-line party hangs up before the mobile operator disconnects the call, the call is automatically disconnected by the terminal.


MOTOROLA
5V / 12V POWER SUPPLIES
CSC
RSC
IRB
RIB 1
RIB 2
RIB 3
TSC
TIB 1
TIB 2
TIB 3
TRUNKED CENTRAL CONTROLLER
MCB
MATRIX
PLIB 1
PLIB 2
PLIB 3
PLIB 4
PLIB 5
TRIB 1
TRIB 2
TRIB 3
TRIB 4
OPTIONAL CENTRAL INTERCONNECT TERMINAL
PULSECOMS

21 CHANNEL CENTRAL CONTROLLER
with CENTRAL INTERCONNECT TERMIANL


DISABLE
RESET
TEST
IND. TEST
ALARM CUTOFF
RUN
DISABLED
ACTIVE
FAILURE
ALARM CUTOFF
RUN
SERVICE ENABLE

MASTER CONTROL BOARD

7. Master Control Board

The Master Control Board (MCB) is the main processing element in the CIT. It is the same as the Central Site Controller (CSC09) hardware.

The MCB software performs the following functions:

a. Telephone interconnect call processing. The appropriate commands required for call processing are routed to the appropriate slave hardware devices via the communications links that are described below.

b. Polled serial link communications with the Phone Line Interface Boards using the ACIA's located on the Matrix board(s).

c. Control of the audio paths through the Matrix board(s).

d. Communications with the Trunked Repeater Interface Board circuits.

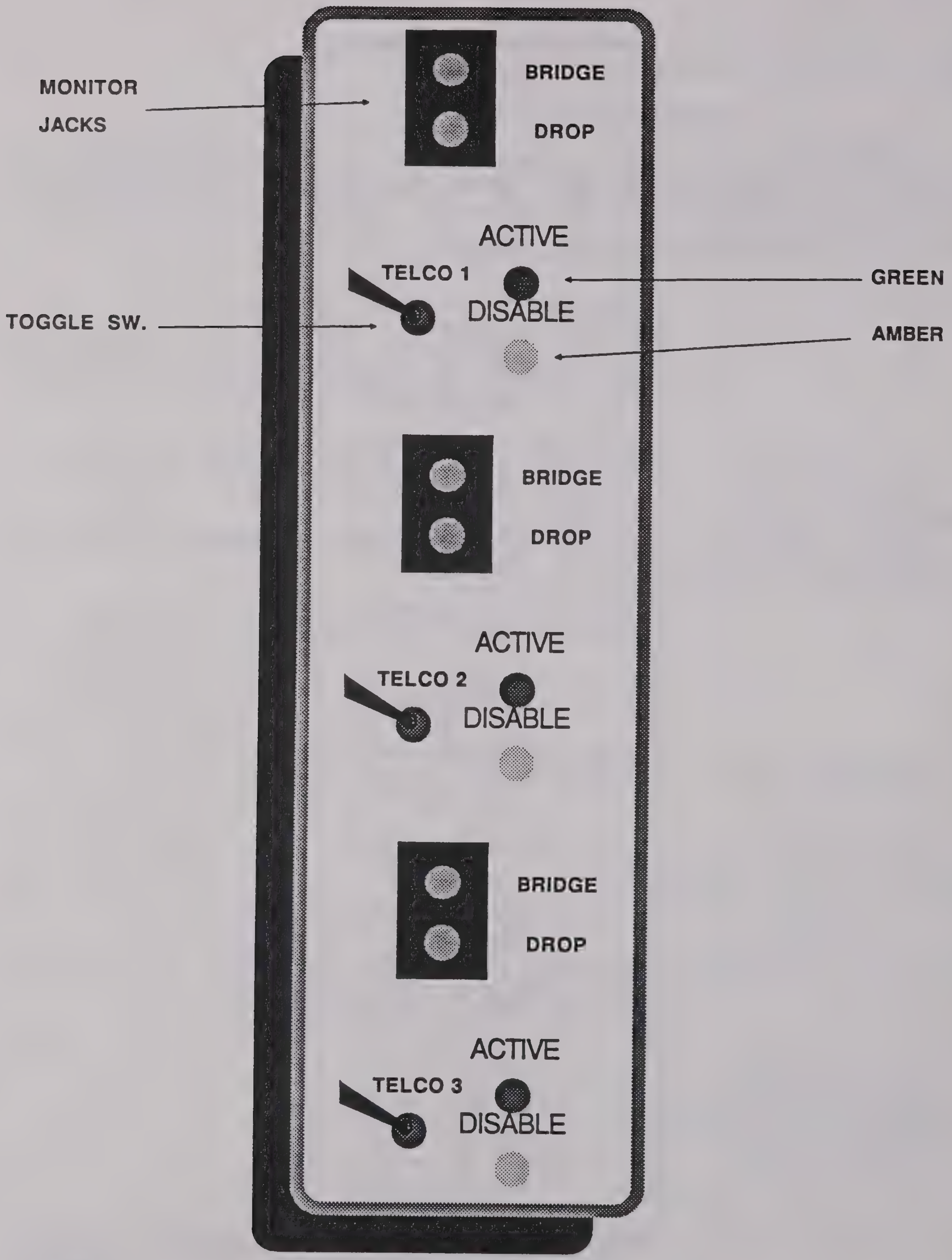
e. Communication with Central Site Controller via the RS-232-C serial link.

f. Communication of system management information to a video display terminal or other external terminal device.

g. Dialing authorization for mobile originated calls.

h. Performs CIT diagnostics

i. Calculates the airtime and phone line charges for billing purposes and outputs these as required to the system manager.


MONITOR
JACKS
BRIDGE
DROP
ACTIVE
TELCO 1
GREEN
TOGGLE SW.
DISABLE
AMBER
BRIDGE
DROP
ACTIVE
TELCO 2
DISABLE
BRIDGE
DROP
ACTIVE
TELCO 3
DISABLE

PHONE LINE INTERFACE BOARD

8. Phone Line Interface Board

The major function of the PLIB is to generate and decode control information from or to the land line telephone and interconnect equipped mobile. Each PLIB contains three TELCO interfaces and the encoding and decoding circuitry necessary to service the following interfaces.

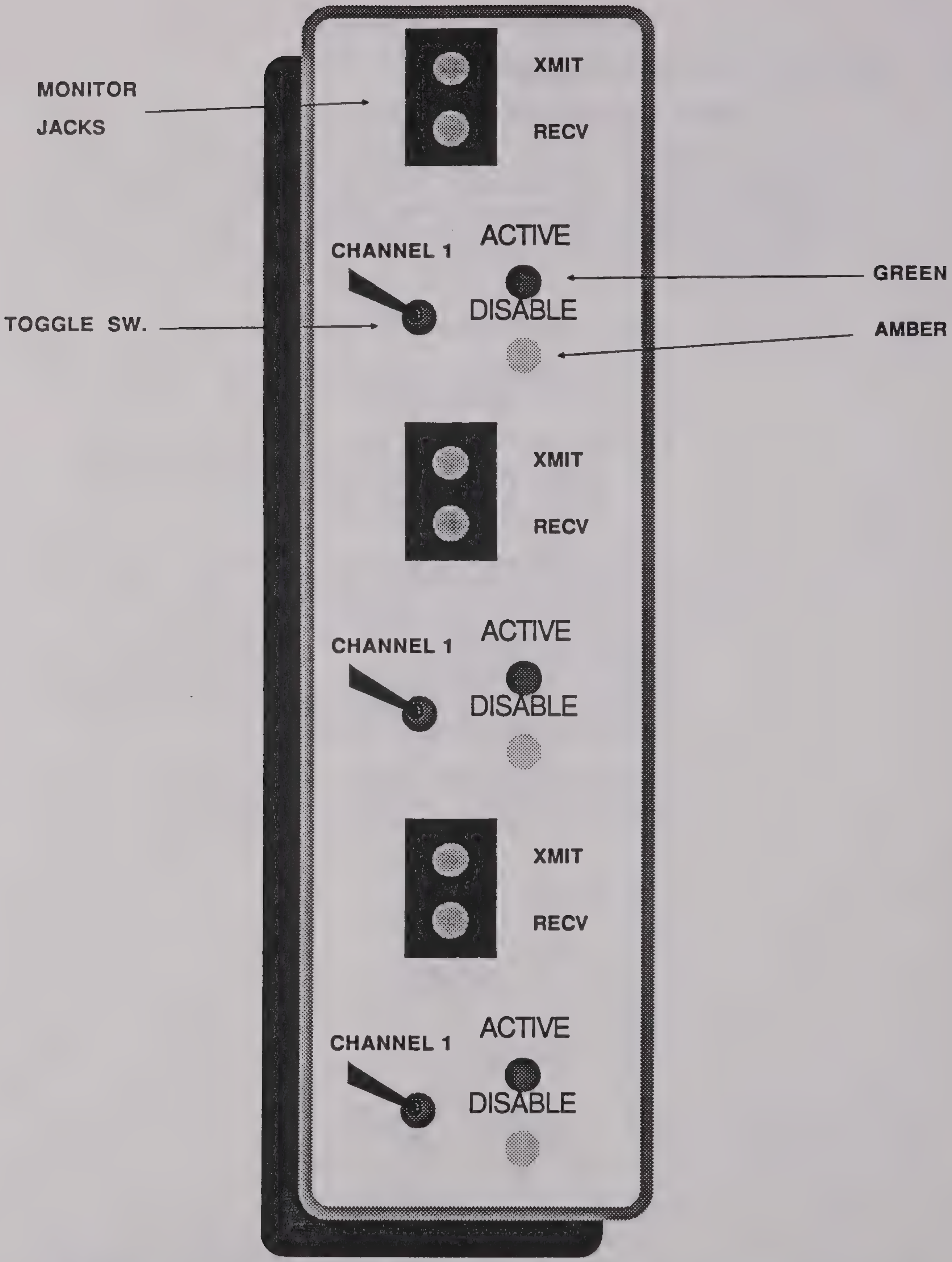
a. TELCO line interfaces consisting of:

   1). Transformer for balanced to unbalanced audio conversion.

   2). Microprocessor control for disconnect, ring, anti-glare, and line seize dial pulse lines from the registered Voice Coupler Units (VCU).

b. Three DTMF decoders and filters for access to the CIT and telephone system. Since dial tone is sent back to mobile and land line users to indicate that the system is ready to accept dialed digits, it is necessary to decoded the DTMF signals in the presence of dial tone. The filters provide the rejection necessary for proper decoding.

c. Monitor jacks are provided for each of the 3 audio circuits. Active and disable indicators are provided for each interface.


MONITOR
JACKS
XMIT
RECV
CHANNEL 1
ACTIVE
GREEN
TOGGLE SW.
DISABLE
AMBER
XMIT
RECV
CHANNEL 1
ACTIVE
DISABLE
XMIT
RECV
CHANNEL 1
ACTIVE
DISABLE

TELEPHONE REPEATER INTERFACE BOARD

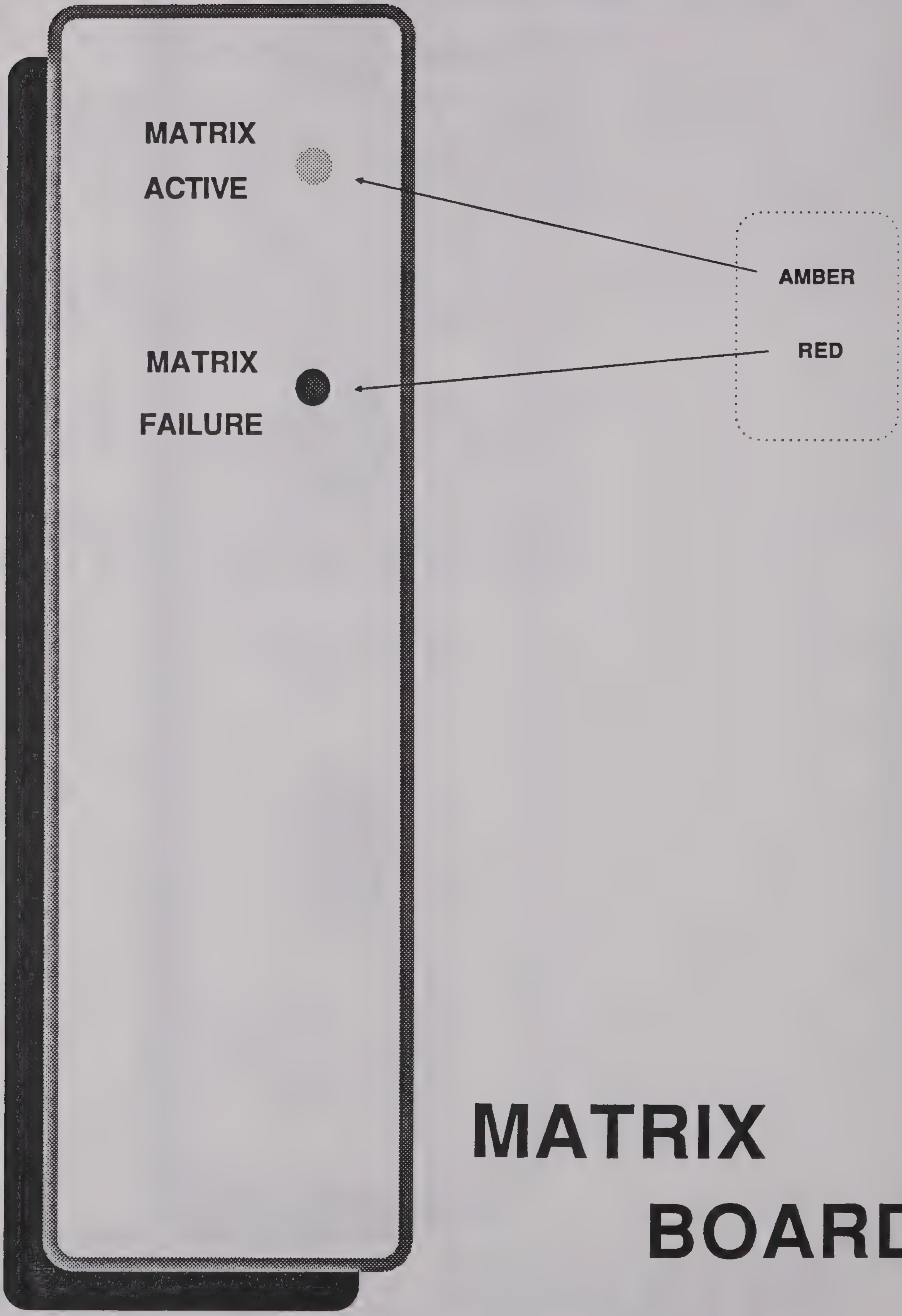
9. **Trunked Repeater Interface Board**

   a. Each telephone repeater interface board (TRIB) is used to interface the CIT from one to three 800 MHz Trunked Repeaters. The board consists of 3 identical analog audio processing sections and 1 digital logic section.

   b. For each audio interface, the board converts a 2-wire unbalanced audio signal from the Matrix Board to balanced 4-wire audio signal to the trunked repeater.

   c. MCB commands executed via the TRIB are the phone line mute function and the repeater "duplex" control. Telephone disconnect is detected for each interface.

   d. Monitor jacks are provided for each of the 3 audio circuits. Active and disable indicators are provided for each interface.


MATRIX
ACTIVE
MATRIX
FAILURE
AMBER
RED

MATRIX BOARD

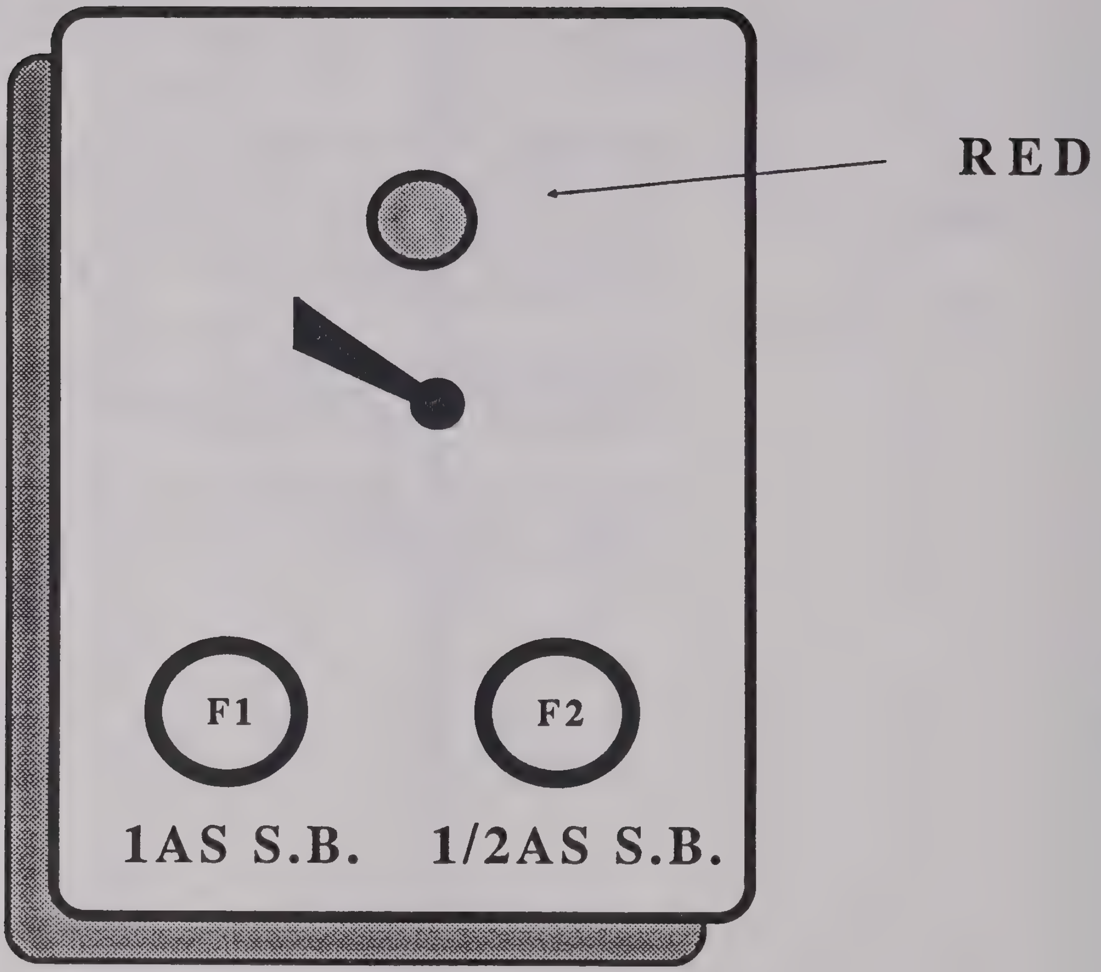
10. Matrix Board

The primary function of the matrix board is to allow the connection of any one of 32 audio paths to any other path. The Matrix is controlled by the Master Control Board.

a. The 6809 microprocessor on the MCB controls the audio path. The audio path is completed between the horizontal repeater line (TRIB) and the horizontal phone line (PLIB) by selecting a common vertical to connect the two horizontal's.

b. Software maintains a table in RAM designating the available repeater and phone line connections (TELL command).

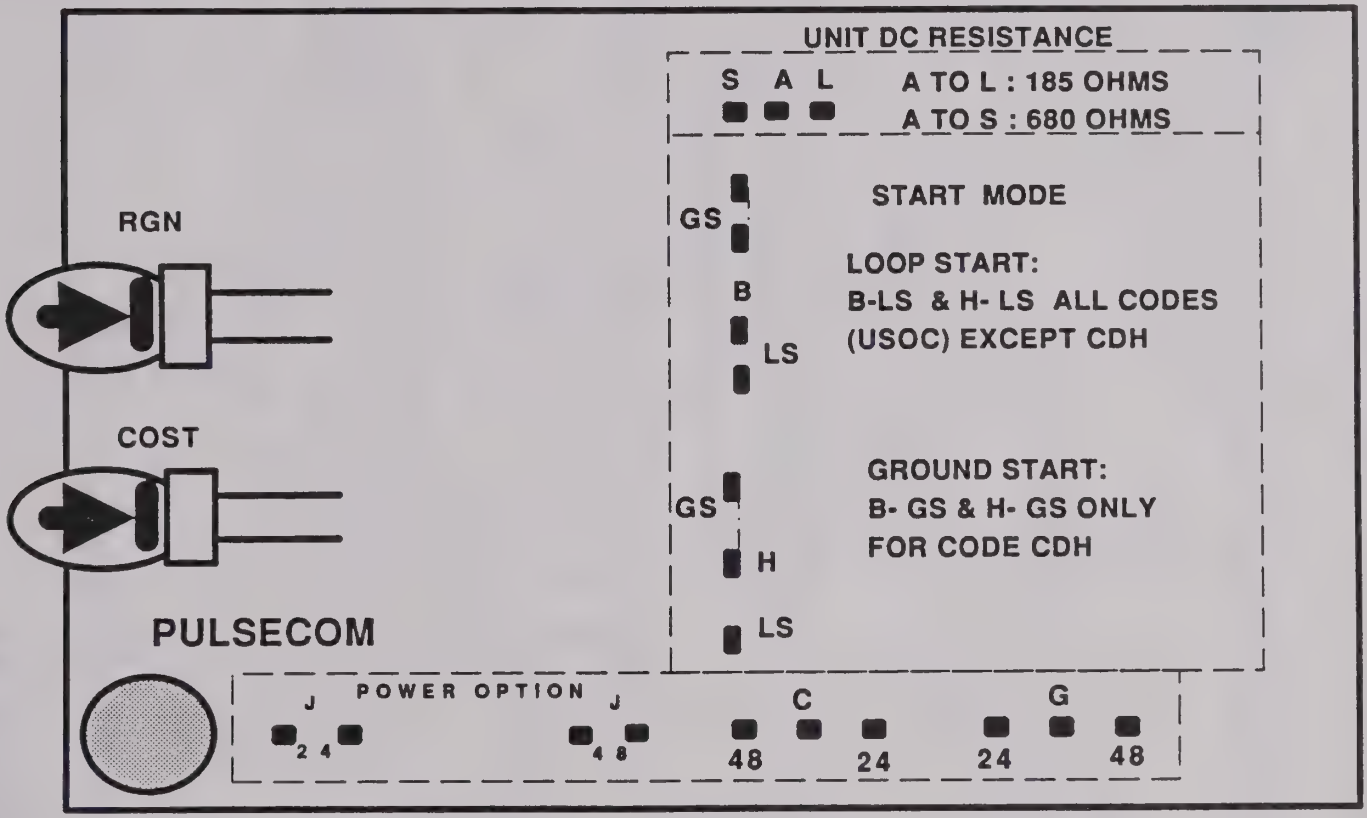
c. The parallel link (PIA) to the TRIB and serial link (ACIA) to the PLIB also reside on the Matrix board.


RED
F1
F2
1AS S.B.
1/2AS S.B.

PULSECOM
POWER SUPPLY

PULSECOM
REGISTERED VOICE COUPLER UNITS

The PULSECOM registered telephone Voice Coupler Unit is used to provide the FCC registered connection to the telephone network. Up to 9 interfaces can be provided in a single PULSECOM rack. This rack includes it's own power supply.


UNIT DC RESISTANCE
S A L
A TO L : 185 OHMS
A TO S : 680 OHMS
START MODE
GS
B
LS
LOOP START:
B-LS & H- LS ALL CODES
(USOC) EXCEPT CDH
GS
H
LS
GROUND START:
B- GS & H- GS ONLY
FOR CODE CDH
RGN
COST
PULSECOM
POWER OPTION
J
2 4
J
4 8
C
48
24
G
24
48

STRAP OPTIONS

ITEM	DESCRIPTION OF OPTION	FUNCTION	STRAP DESIGNATION	NUMBER OF REQUIRED STRAPS	USOC APPLICATIONS
1	UNIT DC RESISTANCE	185 OHMS	A TO L	1	ALL
		680 OHMS	A TO S	1	ALL
2	START MODE	LOOP	B - LS & H - LS	2	ALL EXCEPT CDH
		GROUND	B - GS & h - GS	2	CDH ONLY
3	POWER OPTION	24 Vdc in	C-24, G-24 &J-24	3	ALL
		48 Vdc in	C-48, G-48 & J-48	3	ALL

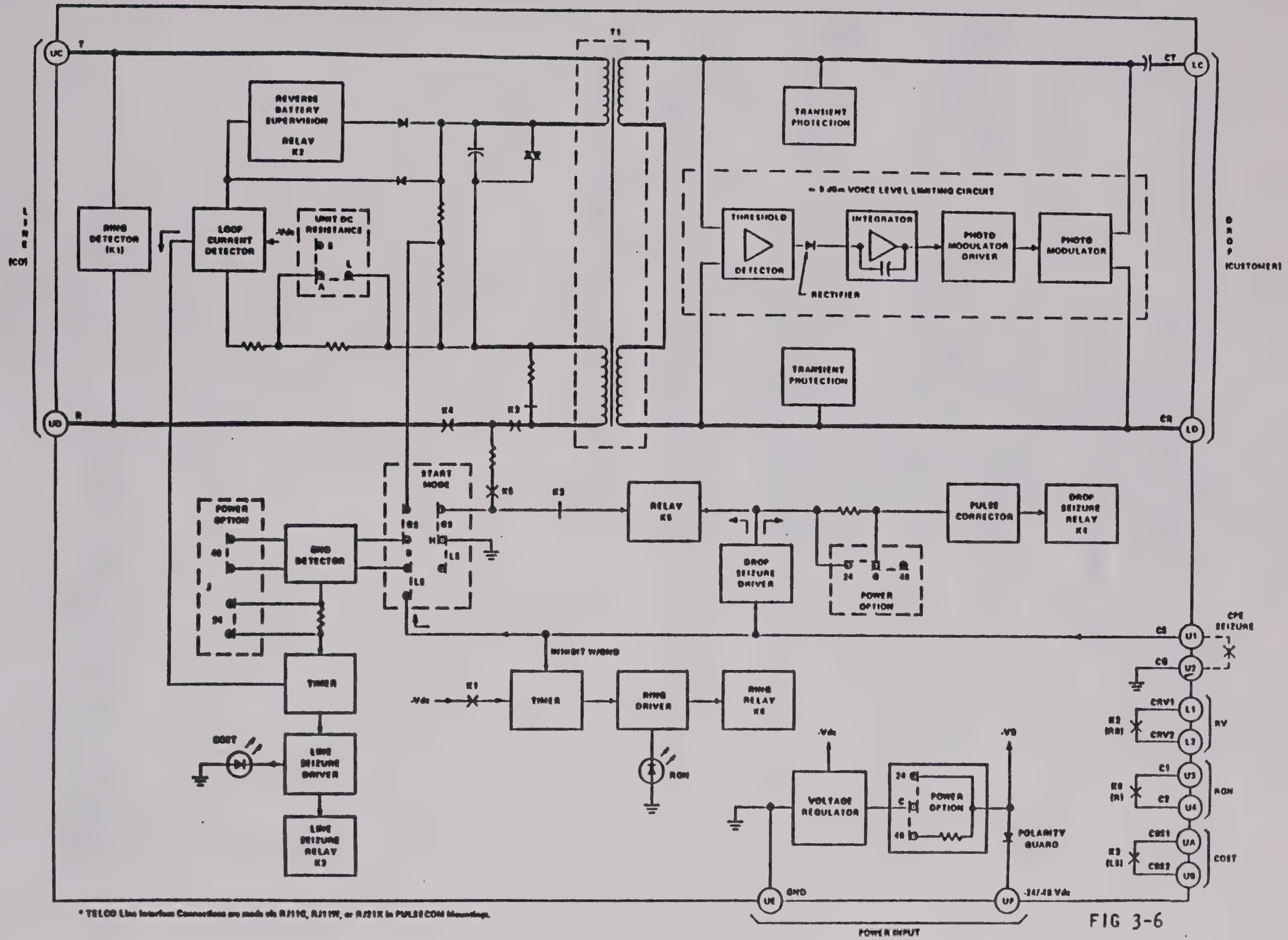
FIG. 3-4

Status of Relays and Led indicators

Item	USOC	Modes of Operation	Effeected by	RELAY STATUS						LED Status		
				K1	K2	K3	K4	K5	K6	RGN	COST	Voice Path
1	CD6 (Loop Start)	Incoming (from CO)										
		(a) idle termination	–	NE	–	NE	NE	–	NE	---	---	CUT
		(b) Incoming Call	Ringing on line	E/DE	–	–	–	–	–	ON/OFF		CUT
		(c) CPE ans. supervision	Short CS&CG leads	E/DE*	–	E	E	–	DE	OFF	ON	CUT THRU
		(d) Call Termination CPE	Removal of CS/CG short	–	–	DE	DE	–	–	–	OFF	CUT
2	CD7, CD8 CET (Loop Start)	Outgoing/CPE originated										
		a) Idle Termination	–	NE	–	NE	NE	–	NE	–	–	CUT
		(b) Outgoing call	CS - CG short	–	–	E	E/DE	–	INHIBIT	–	ON	CUT/CUT THRU
		(c) CO answer supervision	(not provided)	–	–	E	E/DE	–	–	–	–	–
		(d) Call termination CPE	CS - CG short	–	–	DE	DE	–	–	–	OFF	CUT
3	CD9, CED C2ACP, C2AKS (Loop Start)	Incoming CO Originates and Outgoing CPE Originates same as items 1&2 above	Same as items 1 and 2 above									
				K1	K2	K3	K4	K5	K6			
4	CDH Ground Start	(1) Incoming CO originate										
		(a) Idle termination	–	NE	–	NE	NE	–	NE	–	–	CUT
		(b) Incoming Call	Ground on Tip lead	E/DE*	–	E	–	–	E	ON / OFF	GOES ON	CUT
		(c) CPE ans supervision CS-CG short	CS - CG short	–	–	E	E	–	INHIBIT	OFF	–	CUT THRU
		(d) Call termination CO or	Ground removed from Tip, Loop opened	–	–	DE	DE	–	–	–	GOES OFF	CUT
		(e) Call termination CPE	CS - CG short removed	–	–	DE	DE	–	–	–	GOES OFF	CUT
		(2) Outgoing CPE origin.										
		(a) Idle Termination	---	NE	–	NE	NE	–	NE	–	–	CUT
		(b) Outgoing Call	CS-CG short	–	–	E*	**E/DE	**E/DE	INHIBIT	–	ON	CUT/CUT THRU
		(c) CO answer Supervision (OPT)	Reverse battery (application only)	–	(E)	E	–	***DE	–	–	–	–
		(d) Call termination CO or	Ground removal & loop opening	–	DE	DE	DE	DE	–	–	OFF	CUT
		(e) Call termination CPE	CS-CG short removal	–	DE	DE	DE	DE	–	–	OFF	CUT

notes
- * Follows Ringing
- ** Relay K4 follows pulses when indicated as E/DE
- *** Relay K5 energizes to apply GND on the CO Ring lead

FIG. 3-5


UC
T
R
UD
LINE
(CO)
REVERSE BATTERY SUPERVISION
RELAY K2
RING DETECTOR (K1)
LOOP CURRENT DETECTOR
-Vdc
UNIT DC RESISTANCE
S
A
L
T1
K4
K3
CT
LC
CR
LD
TRANSIENT PROTECTION
-9 dBm VOICE LEVEL LIMITING CIRCUIT
THRESHOLD
DETECTOR
RECTIFIER
INTEGRATOR
PHOTO MODULATOR DRIVER
PHOTO MODULATOR
DROP
(CUSTOMER)
START MODE
K5
POWER OPTION
48
24
GND DETECTOR
GS
LS
RELAY K5
DROP SEIZURE DRIVER
PULSE CORRECTOR
DROP SEIZURE RELAY K4
24
G
48
POWER OPTION
INHIBIT WIGND
CS
CG
U1
U2
CPE SEIZURE
TIMER
K1
-Vdc
TIMER
RING DRIVER
RING RELAY K6
RON
COST
LINE SEIZURE DRIVER
LINE SEIZURE RELAY K3
-Vdc
VOLTAGE REGULATOR
POWER OPTION
24
C
48
-VB
POLARITY GUARD
CRV1
CRV2
K2 (RB)
L1
L2
RV
C1
C2
K6 (R)
U3
U4
RON
CBS1
CBS2
K3 (LS)
UA
UB
COST
UE
GND
UF
-24/48 Vdc
POWER INPUT

* TELCO Line Interface Connections are made via RJ11C, RJ11W, or RJ21X in PULSECOM Mountings.

FIG 3-6

11. Call Initiation Protocol

a. Ground Start Operation

1). Idle condition: no signals present on either Tip or Ring.

2). Incoming call: CO applies ground to the Tip lead, along with ring current, (20 to 30 hz). When the loop is closed the ring will trip and the call is in process.

3). Outgoing call: a ground must be placed on the Ring lead to signal the CO. The CO will return ground on the Tip lead. The loop is closed and the customer ground can now be removed.

4). Call termination by CO: when CO ends a call, it is returned to the idle state which will remove ground from the Tip, and open the loop. Call has ended.

5). Call termination by customer: customer opens loop, ground is removed from the Ring Lead, call ends.

b. Loop Start Operation

1). Idle condition: ground is always present on the Tip lead.

2). Incoming call: ring current is applied to the phone line, (20 to 30 Hz). The call is answered by simply closing the loop. Call in progress.

3). Outgoing call: close loop, dial tone is sent by the CO. Open and closing the loop will break dial tone and start the dial process. Dial tone digits will do the same. Call in progress.

4). Call termination by CO: a CO termination will not change the above described situation, and dial tone will return.

5). Call termination by customer: loop is opened, removing ground from Ring Lead. Line goes back to its idle state.

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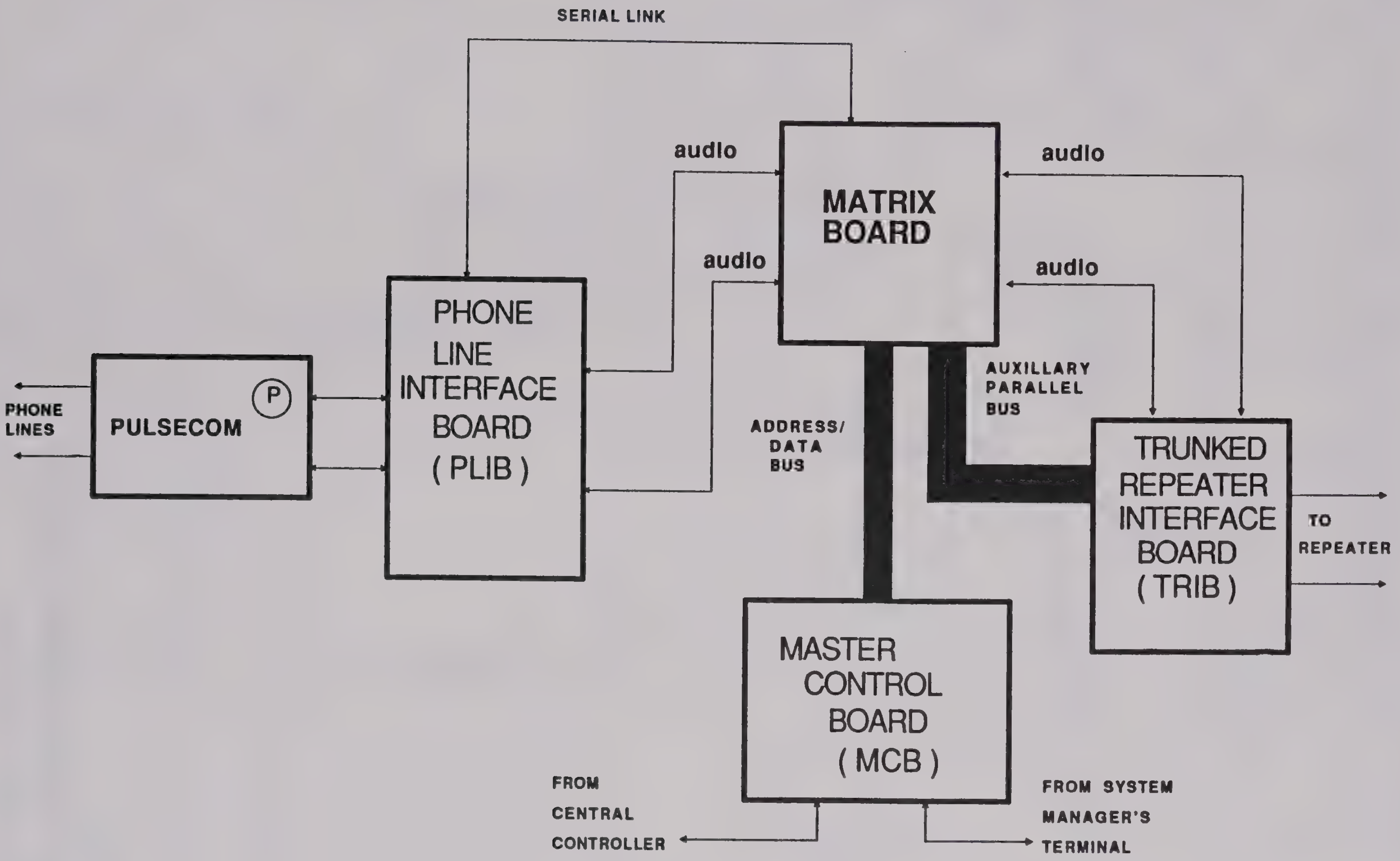
SERIAL LINK
audio
audio
audio
audio
MATRIX BOARD
PHONE LINE INTERFACE BOARD (PLIB)
PHONE LINES
PULSECOM
P
AUXILLARY PARALLEL BUS
ADDRESS/ DATA BUS
TRUNKED REPEATER INTERFACE BOARD (TRIB)
TO REPEATER
MASTER CONTROL BOARD (MCB)
FROM CENTRAL CONTROLLER
FROM SYSTEM MANAGER'S TERMINAL

CENTRAL INTERCONNECT TERMINAL BLOCK DIAGRAM

FIG. 3-2

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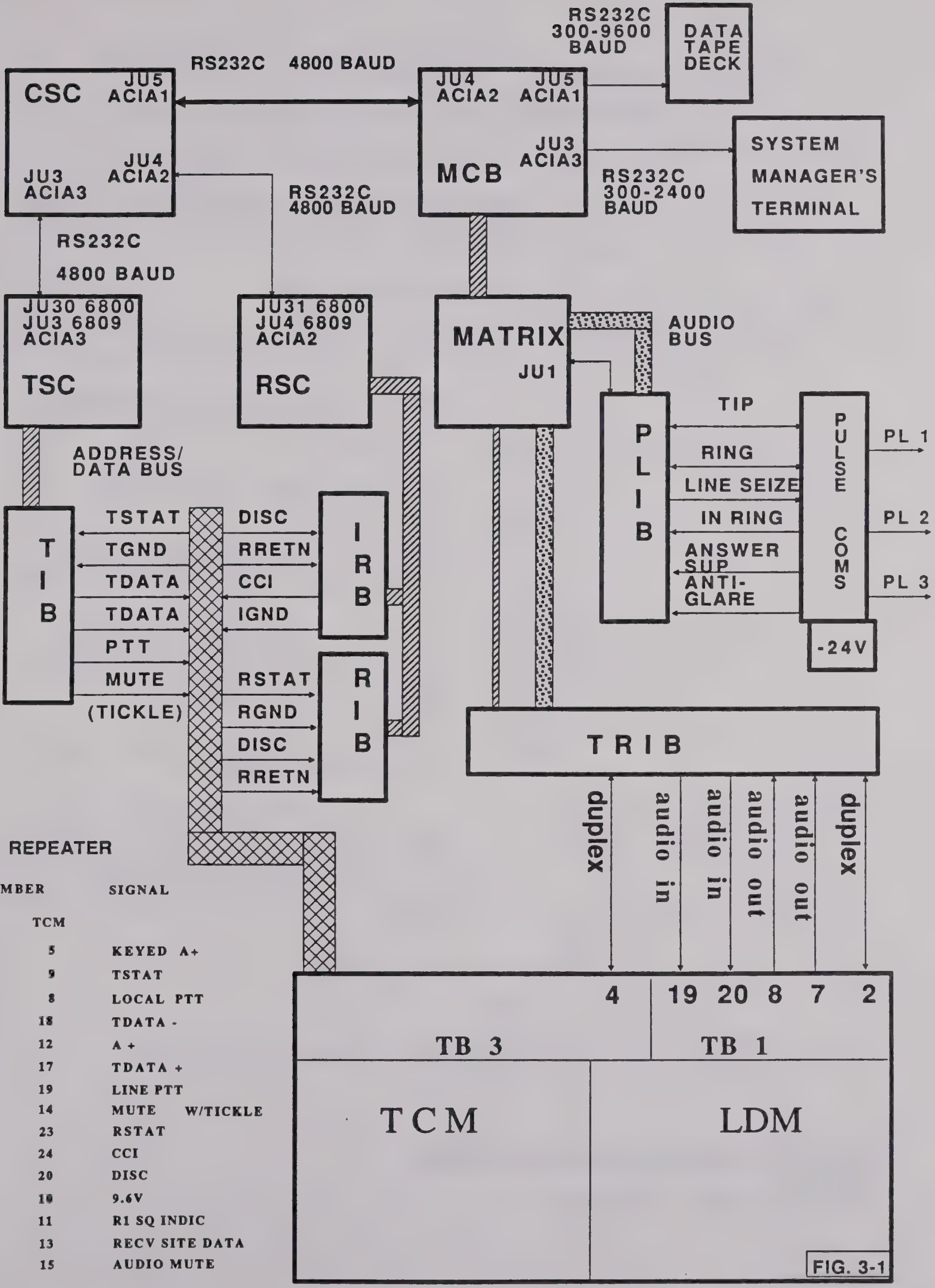

RS232C 4800 BAUD
RS232C 300-9600 BAUD
DATA TAPE DECK
CSC
JU5 ACIA1
JU4 ACIA2
JU3 ACIA3
JU4 ACIA2
JU5 ACIA1
JU3 ACIA3
MCB
SYSTEM MANAGER'S TERMINAL
RS232C 300-2400 BAUD
RS232C 4800 BAUD
RS232C
4800 BAUD
JU30 6800
JU3 6809
ACIA3
TSC
JU31 6800
JU4 6809
ACIA2
RSC
MATRIX
JU1
AUDIO BUS
ADDRESS/ DATA BUS
TIP
RING
LINE SEIZE
IN RING
ANSWER SUP
ANTI-GLARE
PLIB
PULSE COMS
PL 1
PL 2
PL 3
-24V
TIB
TSTAT
TGND
TDATA
TDATA
PTT
MUTE
(TICKLE)
DISC
RRETN
CCI
IGND
IRB
RSTAT
RGND
DISC
RRETN
RIB
TRIB
duplex
audio in
audio in
audio out
audio out
duplex
4
19
20
8
7
2
TB 3
TB 1
TCM
LDM

FIG. 3-1

REPEATER

PIN NUMBER		SIGNAL
TB3	TCM	
	5	KEYED A+
7	9	TSTAT
8	8	LOCAL PTT
9	18	TDATA -
10	12	A +
11	17	TDATA +
12	19	LINE PTT
13	14	MUTE W/TICKLE
15	23	RSTAT
17	24	CCI
19	20	DISC
	10	9.6V
	11	R1 SQ INDIC
	13	RECV SITE DATA
	15	AUDIO MUTE

12. INTERCONNECT CALL SEQUENCE MOBILE TO LAND

a. Radio initially on control channel

1). Depress/toggle the interconnect switch and radio sends an ISW to the central controller.

2). CSC decodes the ISW

a). Tests ID against subscriber records stored in CSC for interconnect.

(1). If not allowed interconnect, two busy OSW's are sent back-to-back.

(2). subscriber gets low beep-beep-beep.

(3). If interconnect switch is still on, subscriber gets out of range tone.

b). If allowed interconnect and no resources available, call kept in queue and subscriber gets a true busy signal from CSC.

(1). Mobile expects to see busy. Call is being processed.

(2). If interconnect channel is available, the CSC assigns an RF voice channel number to the MCB and at the same time, the mobile receives an OSW assigning the voice channel.

b. Radio on voice channel

1). MCB

a). Checks authorization list

(1). Authorization command

(a). Add: authorization record listing.

(2). Subscriber must have an authorization status level of 2 or greater (2, 3, 4, or 5).

(3). A check is done to see if the subscriber is under or over the maximum TELCO charge credit. (i.e. 1 = $50.00) If over, he is dropped.

(4). If these checks fail, he is sent a low speed disconnect word on the voice channel.

(5). The user will not hear dial tone.

b). Passes checks.

(1). MCB instructs PLIB via the data lines through the MATRIX to look for a phone line.

(2). Starting with highest order PLIB (last board to the right).

(a). PLIB 6803 monitors ANTI-GLARE port and relays status via serial communication port.

(b). CBS1-CBS2 on PULSECOM short when phone line in-service.

2). PLIB

a). Assigned PLIB goes off hook to PULSECOM and seizes line with seizure relay.

(1). PLIB place short across PULSECOM'S CS and CG terminals. This applies ground to drop seizure driver, energizing relay K4, and inhibits RGN relay K6.

(2). With K4 energized, a ground pulse is applied to relay K5 which latches itself on through normally open contacts.

(3). Contacts of relay K5 places a ground on the Ring lead to signal the Telephone Central Office (CO).

(4). When CO's switch is conditioned for dialing it returns ground on the TIP lead.

(5). Ground is detected by the ground detect circuit to energize relay K3. Energizing relay K3 does the following:

  (a). Lights cost LED

  (b). Shorts PULSECOM CBS1-CBS2 to signal PLIB that CO is dial ready.

  (c). Contacts completes transmission path and removes idle termination.

(d). Contacts open to de-energizes relay K5 which removes ground from Ring lead. (This ensures that those offices equipped for calling party control will not return dial tone and will totally release when the PLIB releases, thus resetting all circuits for the next calling sequence.)

b). Central Office sends dial tone back to the PLIB.

c). PLIB receives dial tone and tells MCB it has a good line via serial receive lead.

(1). When the 440 Hz Detector is used, JU9 is out, JU10 in.

(2). Upon reception of dial tone, the output of U8 goes low which is read by the 6803 (Microprocessor).

(3). When non-standard dial tone is used, JU9 is in. This keeps U8 low and by the line read by the 6803.

d). MCB instructs PLIB to start re-generating dial tone from sine wave synthesizers.

3). MCB

a). Sends data to MATRIX to connect assigned TRIB "H" lead to assigned PLIB "H" lead.

b). Dial tone from PLIB is then transmitted to the mobile via the TRIB.

D. Telephone Interconnect (continued)

4). Mobile dials digits

a). Dialed digits are received by the TRIB (receive side).

b). From the TRIB, dialed digits are sent to MATRIX board via its "H" lead.

c). Dialed digits are sent from Matrix Board to PLIB's "H" leads.

d). During dialing, digits must be within 10 seconds of each other.

e). During this dialing phase, the audio dialing is connected via the PLIB's Minor Matrix, NOT by the audio connect relays, as the mobile is NOT connected to the phone line yet.

5). PLIB

a). Dialed digits pass through minor matrix, DTMF filters, and are decoded by DTMF decoders.

b). The code of each DTMF tone is read by the PLIB's 6803 microprocessor and sent to the MCB.

c). The PLIB's Micro programs the Sine Wave Synthesizers to REGENERATE each dial tone and send it to the Minor Matrix.

d). From the Minor Matrix, DTMF tones go to proper tip and ring on PLIB board. Tones go from PLIB to PULSECOM TO Central Office.

NOTE: IF dial pulse option is used, mobile dialing opens the CS-CG short for each dial pulse. Relay K4 follows dialing by re-energizing for each dial pulse. This action in turn cuts the CO loop to transmit the dial pulse.

e). As entire number is received, via PLIB, MCB checks number against authorization status.

  (1). If number is authorized, next phase is implemented.

f). Once digits from the mobile have been regenerated and sent to the CO, the PLIB energizes its audio connect relay. There is no answer supervision from the pulsecom.

g). Mobile subscriber unit and landline are now in conversation.

6). Level Limiting Circuit

a). Voice signals applied to either LC-LD or UC-UD terminals enter the threshold detector.

b). If signal level on voice path exceeds -9dBm for a period of approximately 3 seconds, a DC signal appears at output of integrator circuit.

c). This signal is applied to photo modulator driver which lights lamp in photo modulator.

d). Photocell in modulator decreases its resistance in proportion to intensity of lamp.

e). This action lowers the impedance of the LC-LD loop which attenuates the signal level.

7). CSC

a). The length of the time of the call is governed by the Shared Service Algorithm.

b). If time-out occurs, CSC tells MCB to generate warning tone. (Five second dual tone heard by both parties.)

(1). Generated by Sine Wave Synthesizers and applied to audio line via Minor Matrix on PLIB.

(2). In half duplex operation, CSC waits for release of PTT.

(3). In full duplex operation, tone is given immediately.

c). Fifteen seconds after warning tone, CSC ends call.

(1). CSC instructs MCB which deactivates the Major Matrix junction.

(2). CSC un-keys repeater.

(3). MCB mutes TX and RX on TRIB.

(4). Repeater is available for reassignment.

(5). PLIB removes the CS-CG short. This does the following:

(a). Relays K3 and K4 become de-energized.

(b). Cost LED goes out.

(c). Audio transmission path in PULSECOM is cut.

- (d). PULSECOM is returned to the idle state.

8). Call ends (intentionally)

- a). Mobile Ends Call
  - (1). Mobile sends a reject ISW on the CONTROL CHANNEL.
  - (2). CSC reads ISW and initiates call disconnect sequence.
  - (3). Follow sequence beginning at c) (1) above.
- b). Land Line Hangs Up.
  - (1). Central Office removes the tip lead ground.
  - (2). Pulsecom detects loss of loop current and releases relays K3 and K4. This does the following:
    - (a). The short from CBS1 to CBS2 is removed making this line available. PLIB informs the MCB of this.
    - (b). Audio transmission path is cut on the CO side of coupler.
    - (c). Cost LED goes out.
    - (d). Pulsecom is returned to idle state.

*** MISCELLANEOUS MOBILE-TO-LAND NOTES ***

1. When call is in conversation mode, RF from fixed end is modulated with voice and low speed data under control of the CSC. This unmutes mobile.

2. When in conversation mode, mobile transmits voice and low speed connect tone. The tone detectors on the TRIB are not used so connect tone is ignored.

3. In mobile-to-land call, RGN led is never lit.

13. INTERCONNECT CALL SEQUENCE LAND-TO-MOBILE

    a. Initial Call Set-up

        1). Landline Caller Action.

            a). Landline party dials CIT's full telephone number.

            b). Central Office cuts through the transmission path and puts a ground on the tip lead of PULSECOM.

            c). Ground detect circuit detects ground and K3 (line seizure relay) is energized. Relay K3 does the following:

                (1). Cost LED lights.

                (2). Contacts short the leads of CBS1-CBS2. This is an Anti-Glare signal to the PLIB to prevent contention.

                (3). Contacts partially close the loop on the CO side.

            d). Central Office puts ringing on the ring lead.

e). Ringing is detected by ring detector circuit, energizing relays K1 (ring detector) and K6 (ring relay).

(1). K6 energizes and RGN LED lights with each ringing interval (normally 1 second on, 3 seconds off).

(2). K6 provides a short on leads C1-C2 to indicate incoming call ringing to the PLIB.

(3). After two rings, the PLIB notifies the MCB via the Major Matrix of valid incoming call.

f). MCB instructs PLIB to close appropriate line seize/dial pulse relay.

(1). Line seize relay shorts CS-CG on pulsecom.

(2). Ground is applied to drop seizure relay to energize K4 and inhibit K6 (along with the RGN LED).

(3). Transmission and audio path is established.

b. Internal Call Processing

1). Dialing Mobile Digits

a). The prompt tone is generated by the Sine Wave Synthesizers, coupled through the Minor Matrix, to proper tip and ring, to landline caller.

b). Landline party then enters mobile's 4-digit telephone number (DTMF).

- c). DTMF tones are converted to digital signals by PLIB and sent to MCB for translation via the Matrix Board.

2). Master Control Board translation

- a). MCB matches up dialed digits with an ID number on authorization list in memory.
- b). Subscriber attributes are looked up:
    - (1). Is unit being called allowed interconnect calls?
    - (2). Simplex or duplex?
    - (3). Used up his allowed time?
- c). If all checks, the MCB does two things:
    - (1). Directs the PLIB to generate fast ringing back to the land party by way of the Minor Matrix and PULSECOM.
    - (2). Makes a request to the Central Site Controller for an interconnect channel.
- d). If checks do not pass, the MCB directs the PLIB to generate fast busy back to landline caller.
- e). CIT then hangs up.

3). **CSC Actions** (Sent To Landline)

- a). CSC looks for unused interconnect channel.
- b). Finds one and sends OSW on control channel looking for mobile (paging).

c). This is done for 30 seconds or until an Acknowledge ISW is received.

d). After thirty (30) seconds has elapsed, the MCB will be directed by the CSC to stop fast ringing and hang up on land party.

e). If CSC does not have any free RF channels for interconnect, the call is placed in queue and the fast ringing could be heard indefinitely.

4). CSC (On The Control Channel)

a). If there is an available interconnect channel, and the CSC receives an Acknowledge ISW from the mobile, the CSC does two things:

(1). CSC sends back to the mobile a ring OSW.

(2). CSC directs MCB to change the fast ringing to a slow ring.

NOTE: Mobile will ring for a maximum of 60 seconds.

b). When the mobile subscriber answers the call, an interconnect ISW is sent.

c). When the Central Site Controller receives the interconnect ISW, two things happen:

(1). A Voice Channel Grant OSW is sent to the mobile.

(2). The CSC tells the MCB what the assigned voice channel is.

5). Master Control Board

a). MCB directs the Major Matrix to connect the H lead from the PLIB and the H lead from the TRIB together on one common vertical lead.

b). MCB directs the TRIB to energize the duplex control relay K1 if the mobile is full duplex.

NOTE: Time-out sequence is identical to the mobile-to-land call sequence.

INTERCONNECT
LANDLINE TO MOBILE

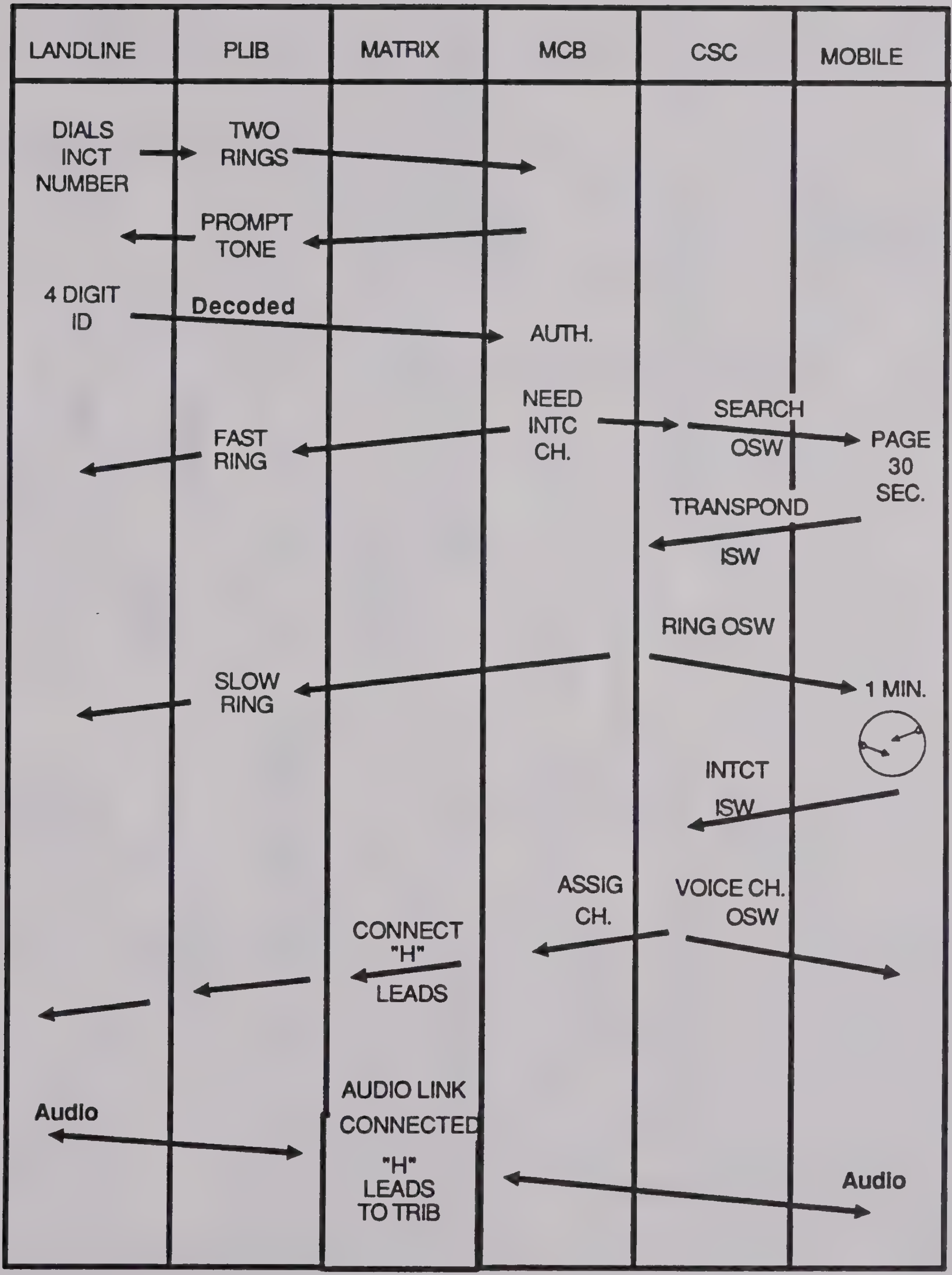
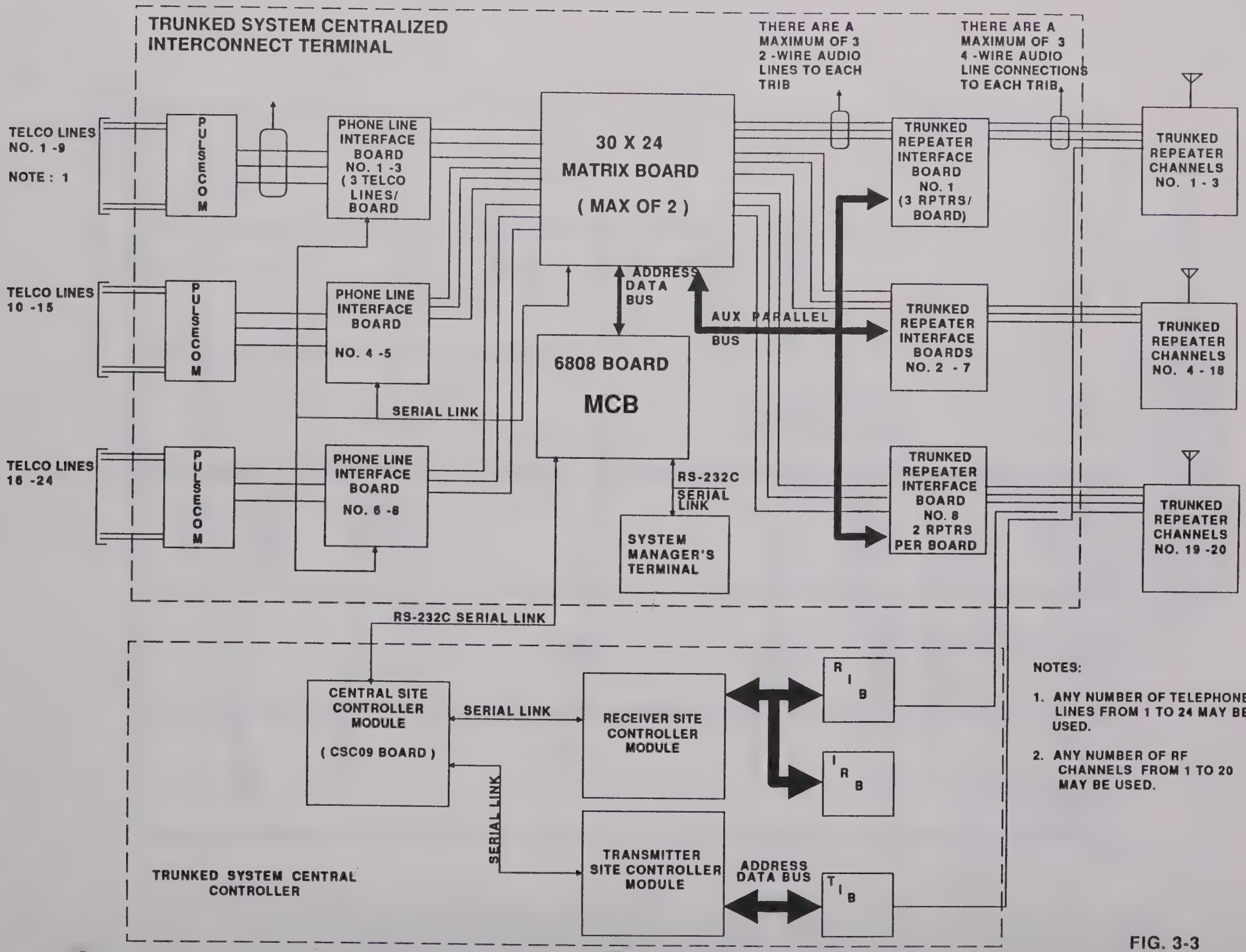

LANDLINE
PLIB
MATRIX
MCB
CSC
MOBILE
DIALS INCT NUMBER
TWO RINGS
PROMPT TONE
4 DIGIT ID
Decoded
AUTH.
NEED INTC CH.
SEARCH OSW
PAGE 30 SEC.
FAST RING
TRANSPOND ISW
RING OSW
SLOW RING
1 MIN.
INTCT ISW
ASSIG CH.
VOICE CH. OSW
CONNECT "H" LEADS
AUDIO LINK CONNECTED
"H" LEADS TO TRIB
Audio
Audio

FIG. 3-7

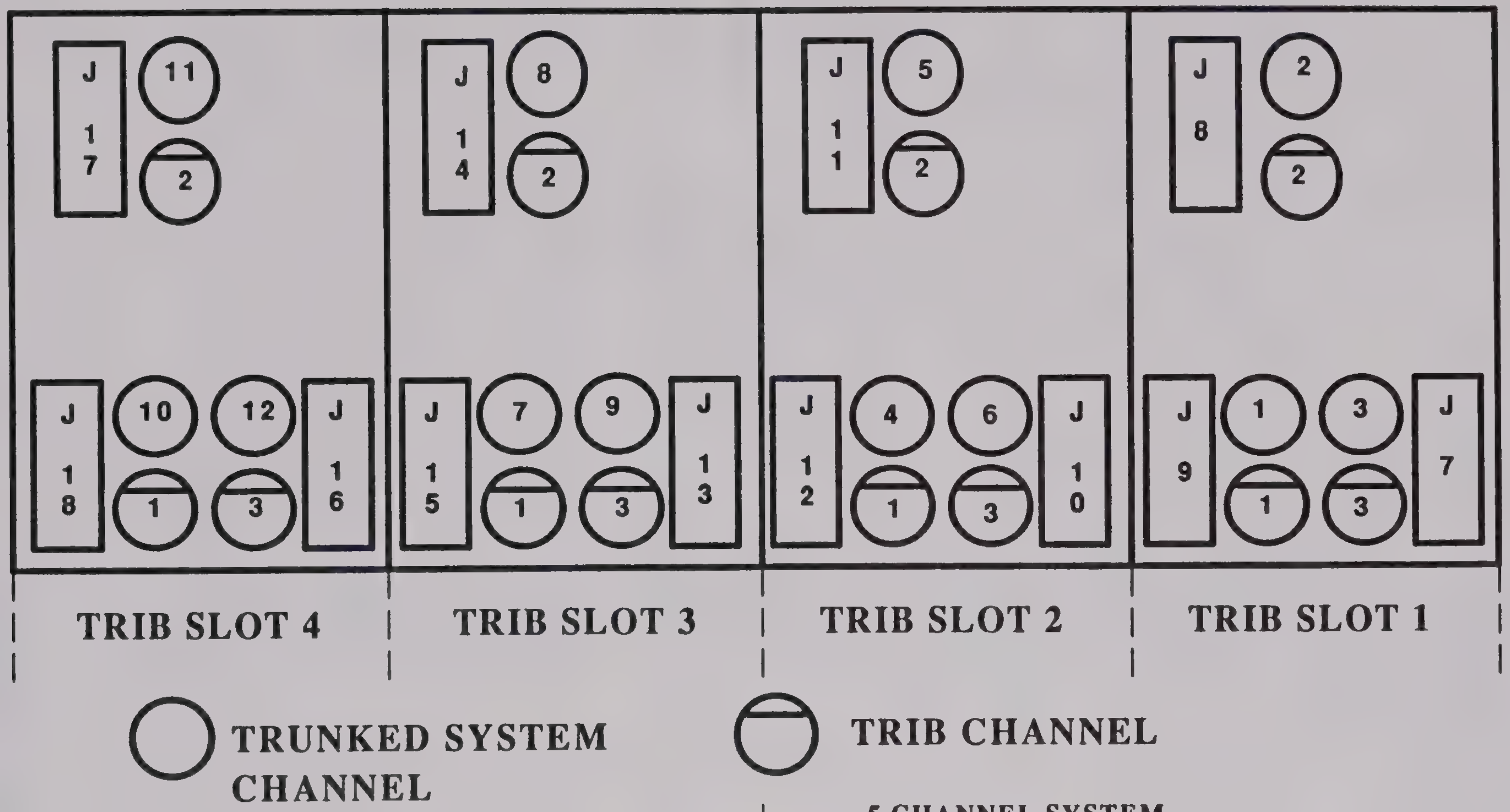

TRUNKED SYSTEM CENTRALIZED INTERCONNECT TERMINAL
THERE ARE A MAXIMUM OF 3 2 -WIRE AUDIO LINES TO EACH TRIB
THERE ARE A MAXIMUM OF 3 4 -WIRE AUDIO LINE CONNECTIONS TO EACH TRIB
TELCO LINES NO. 1 -9
NOTE : 1
TELCO LINES 10 -15
TELCO LINES 16 -24
PULSECOM
PULSECOM
PULSECOM
PHONE LINE INTERFACE BOARD NO. 1 -3 (3 TELCO LINES/ BOARD
PHONE LINE INTERFACE BOARD NO. 4 -5
PHONE LINE INTERFACE BOARD NO. 6 -8
30 X 24 MATRIX BOARD (MAX OF 2)
ADDRESS DATA BUS
AUX PARALLEL BUS
6808 BOARD MCB
SERIAL LINK
RS-232C SERIAL LINK
SYSTEM MANAGER'S TERMINAL
TRUNKED REPEATER INTERFACE BOARD NO. 1 (3 RPTRS/ BOARD)
TRUNKED REPEATER INTERFACE BOARDS NO. 2 - 7
TRUNKED REPEATER INTERFACE BOARD NO. 8 2 RPTRS PER BOARD
TRUNKED REPEATER CHANNELS NO. 1 - 3
TRUNKED REPEATER CHANNELS NO. 4 - 18
TRUNKED REPEATER CHANNELS NO. 19 -20
RS-232C SERIAL LINK
CENTRAL SITE CONTROLLER MODULE (CSC09 BOARD)
SERIAL LINK
RECEIVER SITE CONTROLLER MODULE
SERIAL LINK
TRANSMITTER SITE CONTROLLER MODULE
ADDRESS DATA BUS
RIB
IRB
TIB
TRUNKED SYSTEM CENTRAL CONTROLLER

NOTES:

1. ANY NUMBER OF TELEPHONE LINES FROM 1 TO 24 MAY BE USED.

2. ANY NUMBER OF RF CHANNELS FROM 1 TO 20 MAY BE USED.

FIG. 3-3



J 17
11
2
J 18
10
1
12
3
J 16
J 14
8
2
J 15
7
1
9
3
J 13
J 11
5
2
J 12
4
1
6
3
J 10
J 8
2
2
J 9
1
1
3
3
J 7
TRIB SLOT 4
TRIB SLOT 3
TRIB SLOT 2
TRIB SLOT 1
TRUNKED SYSTEM CHANNEL
TRIB CHANNEL

7 CHANNEL SYTEM
CHAN 1, 2, 3 INTERCONNECT: CHAN 6, 7

TRIB SLOT 1		TRIB SLOT 2	
CEN. RF CHAN	1	RPTR INTERFACE	1
	2		2
	3		3
	4		X
	5		X
	6		1
	7		2

5 CHANNEL SYSTEM
CHAN 4, 5 INTERCONNECT

TRIB SLOT 1			
RF	1	INTERFACE	X
	2		X
	3		X
	4		1
	5		2

FIG. 3-8

D. Telephone Interconnect (continued)

14. Detailed Board Descriptions

a. Matrix Board

1). BOARD DESCRIPTION

a). The primary function of the MATRIX board is to connect a path between repeater and telephone audio. Bi-directional horizontal's on the Matrix Board are selected through software to connect to repeater lines on the TRIB and phone lines on the PLIB. An audio path is completed between the horizontal repeater line and the horizontal phone line by selecting a common vertical to connect to the two horizontal's. A -5v voltage regulator supplies the matrix chips to allow audio on the horizontal's to swing from +5v to -5v. The 6809 microprocessor on the MCB controls the switching connection of a vertical to a horizontal. Software maintains a table in ram designating the available repeater and phone line connections.

b). The parallel link to the TRIB and serial link to the PLIB also reside on the matrix board. A PIA is the parallel link with slow address and bi-directional slow data outputs. A slow data read/write signal and strobe signal control the slow data transmission to and from the TRIB. An ACIA is the serial link. A 1.8432 Mhz crystal oscillator supplies the receive and transmit clock on the ACIA. This frequency, divided by two, supplies the ACIA's on the PLIB.

c). Two indicator lights give the status of the Matrix Board during a 6809 master test. An amber light indicates proper functions. A red light indicates a failure.

2). MATRIX DECODE

a). The matrix decode circuit decodes the horizontal and vertical line connection or disconnection in the matrix array. The signals MXAE (U8a-4) and MXSW (U8b-11) are inputs to the matrix decode circuitry.

b). Address lines A0-A4 enter the matrix board from the inverting receiver U11 and stop at the inputs of latch U16. Lows on U2-1 and U2-19 send data to latch U16. A high signal on U8b-11 makes a low to high transition, address and data are latched to U14 and U16. The output data (Do-D4) and addresses (A0-A4) of U14 and U16 are sent through open collector buffers U5 and U4 to pull the TTL outputs up to CMOS level inputs.

c). Data appears at the inputs of 2 CMOS - 4 to 16 decoder/latches, U6 and U7. D0-D3 are the select inputs to U6 and U7. D4 selects the decoder (U6,U7). A low on U6, U7-23 enables the decoder. D4 low enables U6 and disables U7 due to the invertor U10a placed before U7-23. D4 high enables U7 and disables U6. The outputs of U6 and U7 (DV0-DV23) are data inputs to the matrix chips (U20-U43). When a decode occurs, only the decoded output goes high and all other inputs remain low (table 2).

3). THE MATRIX CHIPS (U20-U43)

a). Each matrix chip houses 32 crosspoint switches within an 8 x 4 array. Inputs to the chip turn the crosspoint switches "ON" and "OFF." Address inputs select the horizontal-line. Data inputs select the vertical line(s). A high address enable signal to the chip turns the corresponding crosspoint switch(s) "on" which connects the vertical line(s) to the horizontal.

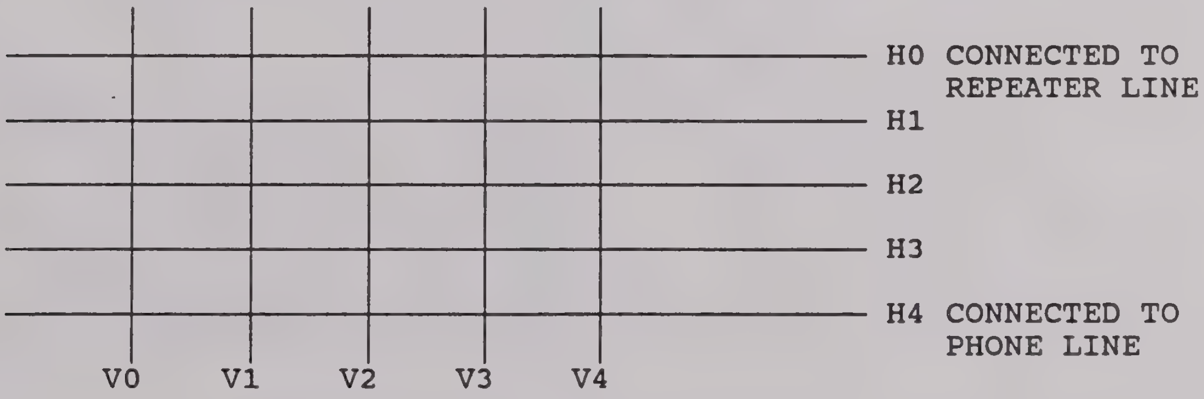
4). THE MATRIX ARRAY: CONNECTING A VERTICAL TO A HORIZONTAL

a). The matrix array is a 30 x 24 array within a 4 x 6 array. The matrix chips (U20-U43) make up the 4 row x 6 column array. Eight horizontal lines are outputs from each row in the array, giving a total of 32 horizontal lines as output. The Matrix Board omits the last two horizontal,s in the fourth row allowing 30 horizontal's for connection. Four vertical lines are output from each column in the array, giving a total of 24 vertical lines.

b). The decode outputs from U6 and U7 (DV0-DV23) are outputs to the array to select one of the 24 vertical lines (V0-V23). DV0-DV23 are divided into six groups of four and each group is presented to a column of matrix chips as data inputs.

c). The address outputs from latch U16 (A0-A2) select one of the eight horizontal lines (H0-H7) within a row of matrix chips. The decode outputs (AE1-AE4) select a row of matrix chips by supplying the address enable signal to a row of matrix chips. Because the address enable signal is supplied to a row of matrix chips, a horizontal may be selected once to make a vertical connection. Selection of the same horizontal to a second vertical connection will erase the previous horizontal to vertical connection. However, the same vertical may be selected to connect to an infinite number of horizontal's.

BELOW IS A DIAGRAM OF THE VERTICAL AND HORIZONTAL CONNECTION WHICH ALLOWS A PATH BETWEEN REPEATER AND TELEPHONE LINES.



IN THIS DIAGRAM, V1 IS SELECTED TO CONNECT TO H0 AND H4. V1 IS THE CONNECTING PATH FOR REPEATER AND TELEPHONE AUDIO.

TO DISCONNECT A HORIZONTAL FROM A VERTICAL, THE ADDRESS LINES ARE CHOSEN TO SELECT THE HORIZONTAL FOR DISCONNECTION. THE DATA LINES ARE CONFIGURED AS FOLLOWS:

D4:U14	D3:U14-9	D2:U14-6	D1:U14-5	D0:U14-2
1	1	0	0	0

ONLY V0-V4 ARE ACCESSIBLE ON THE TRN5686A.

5). RESET

a). The reset signal is an active low input signal to the PIA (U3-34) and an active high signal to the matrix chip (U20-U43)-18). An active reset clears the PIA's registers and disconnects all vertical to horizontal connections in the matrix array.

6). LED CONTROL

a). The LED's on the matrix board indicate status of the board. During a 6809 master test, a red light indicates a failure within the matrix array. An amber light indicates proper functioning.

b. Telephone Repeater Interface Board

1). BOARD DESCRIPTION

a). THE TRUNKED REPEATER INTERFACE BOARD (TRIB) is used to interface the Trunked Centralized Interconnect Terminal to up to three 800 MHz trunked repeaters. The board consists of three identical analog audio processing sections and one digital logic section.

2). DIGITAL LOGIC SECTION

a). The digital logic section allows the MCB to control all major board functions through the use of a PIA on the Matrix Board which generates a parallel bus. This parallel bus can address up to 16 TRIB's by using the "A" side I/O BINs configured as addresses.

The TRIB's are identical, but their address on the parallel bus is determined by their physical location on the backplane. The "B" side of the PIA forms the 8 bits of bi-directional data lines. A read/write line is formed by configuring CA2 on the matrix PIA as an output. CB2 is a write strobe, latching data from the MCB on the TRIB.

3). AUDIO SECTION

a). The audio section splits the two-wire bi-directional phone link audio from the matrix board into separate transmit and receive audio paths. A balance network is provided to compensate for different line impedances.

b). TRANSMIT AUDIO PATH - Audio from the phone line goes to a speech detection circuit, when speech is present, AGC is applied to provide a constant audio level to the repeater. Audio gain is also reduced when the receiver audio circuit detects activity. This reduces the amount of receiver audio that is sent to the transmitter due to an unbalanced hybrid.

c). RECEIVE AUDIO PATH - Audio from the receiver goes to a level detector that adjusts the gain of the path. The gain is reduced when the receiver audio falls below a preset level. This reduces the amount of noise the land line party hears when the mobile party is not talking.

d). OTHER FUNCTIONS - The MCB can mute the repeater transmit and receive audio paths on the TRIB by audio switches addressed on the parallel bus. The MCB can also set the repeater duplex control relays.

4). THEORY OF OPERATION

a). RECEIVE AUDIO PATH - Balanced audio from the repeater goes to matching transformer T4. Audio from the output of T4 is sampled by the mobile disconnect detector via U3B, and the mobile activity checker via U2A. The main audio path is through R5, the level setting pot, to buffer U3A then through the variable gain amplifier, U1A, to the hybrid.

The mobile activity checker, U2A, U2B; samples the mobile's audio and lowers the gain of the variable gain amplifier, U1A, when there is no mobile audio detected. When the mobile party stops speaking, the gain of U1A drops, reducing the background noise that the land line party hears.

b). MOBILE DISCONNECT DETECTOR - Mobile audio is sampled by U3B and sent to the tone decoders, U10 and U11. When the mobile sends an alternative 900 hz, 600 hz sequence, the output of the tone detector is sent to counter U14 via flip-flop U13A,B. U14 counts the number of tone bursts received and when the number set by JU1 is reached, flip-flop U28A is set. The status of this flip-flop may be read and reset via the parallel bus. U13C triggers monostable U15 whenever a tone is detected.

The monostable opens a 200 mS window. If no additional tones are detected during this time, the counter, U14, is reset and the circuit starts looking for a new disconnect sequence.

c). TRANSMIT AUDIO PATH - Phone line audio comes through the hybrid to the input of amplifier U1B. This amplifier feeds the increaser and a variable attenuator. Components R38 and VR1 act as a variable photo-attenuator; VR1 consists of an led and a photo-resistor in a sealed package. An increase in the led current will cause a decrease in the value of the photo-resistor. The current, through the led, is controlled by the base bias of current source Q1. The closer to the ground the base of Q1 is pulled, the greater the attenuation caused by the photo-resistor. The attenuator is followed by a 6 DB gain amplifier U8A which presents a low output impedance for the next variable gain amplifier U9A.

Gain variations are accomplished by VR2 with R42 in parallel. The more positive the output of U8B, the more current flows through the VR2 led, increasing the gain of U9A.

The output of U9A drives the matching transformer T3 which feeds the transmitter. The output of U9A is also applied to R4, the output level control, which controls the level at which the decreaser starts to work. U9B amplifies the output of the output level control and feeds the CR12, CR13 rectifying circuit.

The rectified output, if it is large enough, will turn on Q2 which will then remove the charge from C22. Capacitor C22 is the main storage element in the AGC loop. Removing a charge from the capacitor lowers the output voltage of U8B and causes both VR1 and VR2 to lower the gain of the amplifier string. There is also an idle gain control, R3, which feeds C22 through 1 Meg ohm in order to achieve a long time constant. If the audio level calls for neither an increase or a decrease in gain, the voltage on C22 will slowly return to the voltage set by the idle gain control. The increaser circuit increases the gain of the amplifier string when the land line party is talking and the output level is below the point which would call for decreaser action. Voice normally has strong frequency components at 1200 hz and has a syllabic rate centered at 7 hz.

The output of U1B is fed through R2, the increaser gain control, to high pass filter U4A and then low pass filter U4B. These two filters form a sharp high gain band pass filter centered at 1200 hz. The output of U4B is rectified by CR2 and CR3 and stored in C13. Capacitor C13 is small enough so that the 7 hz centered speech envelope is not attenuated. A feedback circuit consisting of R15, R16, R17, and C11 is used to provide agc for the 1200 hz filter so that the speech envelope is not stripped off by limiting.

The speech envelope next goes through a high pass filter U5A and low pass filter U5B. These two filters form a 7 hz bandpass filter to detect the syllabic rate.

If the output of U5B is high enough, it is rectified by CR7 and CR8 and applied to the input of the increaser switch U7B. If this input is high enough, the output at pin 7 of U7B will go to +12 vdc. This will allow current to flow through R33 and CR9 to increase the charge in storage capacitor C22. If the voltage on C22 is raised, VR1 and VR2 will cause an increase in gain of the amplifier string.

In some cases it is desirable to inhibit the increaser function. When the output is high enough to activate the decrease function, the increaser switch is inhibited by Q7. When the mobile party is talking, the increaser is inhibited by Q8 which is driven from the voice operated sidetone suppression circuit.

The sidetone suppression circuit also lowers the gain of the transmit amplifier string when the mobile party is talking. This gain reduction is adjusted by R100.

5). BOARD ADDRESSING AND DATA FLOW

a). The TRIB boards are identical, but their address on the parallel bus is determined by their physical location on the backplane. U17 and U18A form the board ID decoder.

If the board location as read from the parallel bus (pin 8 of U18A) (board select) goes low enabling demultiplexer U20. U20 looks at the status of circuit select 0, circuit select 1, read/write, and strobe and then outputs the appropriate logic to read data from, or write data to, the TRIB.

b). IN THE READ MODE - The output side of buffer U19 is activated and the board present data is available to the data bus. Multiplexer U24 decodes the circuit select lines and switches the appropriate channel's disable switch and disconnect detector data through buffer U19 to the data bus.

c). IN THE WRITE MODE - The input side of buffer U19 is activated. U20 decodes the circuit select lines and sends the appropriate data through buffer U19 to one of the clock inputs of the data latches U21, U22 or U23. Data from the data bus is latched into the selected latch and is available to that circuit. This data consists of reset, mute, gain freeze, duplex and disable led.

c. Phone Line Interface Board (PLIB)

1). Function

a). The Phone Line Interface Board (PLIB) serves as an interface between the telephone system and the rest of the ICU. The PLIB senses and acts on all the signals provided by the landline. It also serves to decode and regenerate mobile based dialing.

These functions and all other aspects of call assignment are processed based on data communicated to the PLIB via the serial data link.

2). Functional Description - The board can be separated into the following areas :

a). **Microprocessor:** A Motorola MC6803 single chip microprocessor serves as the controller for tone generation, serial communication, interconnection of resources and for reading external signals.

b). **EPROM:** 12k x 8 bytes of permanent program storage, expandable to 16K x 8 bytes.

c). **RAM:** The processor contains 128 x 8 bytes of Random Access Memory. The board has an additional 4K x 8 bytes of static RAM.

d). **Telco Interface:** Each PLIB can interface to three phone lines via a registered phone interface. The Telco interfaces provide a balanced audio signal and will generate three output signals for the PLIB: Ringing, Anti-glare (busy) and land line disconnect. In addition it will receive a line-seize/dial pulse output from the PLIB.

e). **Tone Synthesizers:** Three pairs (6) used to generate DTMF tones as well as audio and status signals.

f). **DTMF Filters-Decoders:** Three pairs (6), used to decode received signal from land line to digital info for mobile ID and to allow microprocessor to check authorization of a mobile to land call prior to allowing call to be processed.

g). **Trunking Filters:** Used for transmitting and receiving trunking compatible data.

h). **Dial Tone Detector:** Verifies a phone line is "active" and has a dial tone on it prior to PLIB attempting to use it for outgoing call.

i). **Matrix:** A cross point switch arrangement used for interconnecting the various resources on the PLIB.

J). **Output Latches:** IC's U11, U21 and U24 used for latching data from the data bus to external devices. Used as Write Only memory.

3). Detailed Description

a). **Microprocessor:** The 6803 processor is a 8 bit Rom-less version of the 6800 which uses 4K x 8 bytes of external EPROM for program storage and acts as:

(1). An interface between phone lines and the trunked system

(2). An analog signal controller and generator. 128 bytes of internal RAM supplemented by 4K bytes of external RAM is available. The 6803 has an internal UART that performs serial communication with the Matrix board. The PLIB contains extra sockets for expansion of up to 16 K bytes.

b). **Serial Transmitter:** The data link transmitter consists of a single open collector LSTTL gate (U33 pins 4, 5, 6). The transmitter is used to send data to other boards.

The data sent varies from; status of on board modules, to front panel switch information, to the digits dialed by a caller.

The communication format is; 8 bits of data, 1 start bit, 1 stop bit and no parity bits. Data rate is nominally 4800 baud in both directions, however data rate is actually determined by frequency of the serial clock.

c). **Serial Receiver:** Consists of a single invertor with hysterisis (U1 pins 11, 9). The hysterisis is used to clean up any noise or jitter that may have been introduced onto the signal. The output of this gate is fed directly to the serial receive pin on the processor.

d). **Output Latch:** Each circuit has an address which is decoded by the address decoders. Their inputs are on the data bus. To send data to one of these devices, the processor uses a standard write cycle addressing the latches as it would any other memory chip. It writes data onto the bus and the chip select generated by the address decoder is used to latch the data to these devices.

Data from U21 is used exclusively for minor matrix control. Three lines from U24 are also used for matrix control. The three lines are used for gain control and one is controlling the Telco 3 disable LED.

The latched outputs of U11 control three types of signals. Three lines of octal latch (pins 2,5,6) control the audio cut-through relays.

In order to maintain audio quality, the voice signal processing is minimized. Telco and Matrix board audio are connected directly without additional filtering on the PLIB. The cut-through relays are used to connect the Telco lines to the Matrix boards audio lines.

Three lines (pins 9, 12, 15) control the line seize/dial pulse signals. These pins drive relays which serve the dual purpose of dial pulsing digits and taking a telco line "off hook". These latched signals also drive the green "active" LEDs. The remaining two lines control the "disable" Leds for telco lines 1 and 2.

e). **Dial Tone Detector:** The dial tone detector consists of a phase locked loop tone detector tuned to 440 Hz. Pin 8 of the detector is an open collector output that is driven low when a tone is detected.

f). **Trunking Transmit Filter:** This is a single pole de-emphasis filter with a corner at 300 Hz.

g). **Trunking Receive Filter:** A seven pole, low pass Bessel filter with a corner freq. of 2050 Hz that is used to remove any high frequency noise from the received data that may have been introduced by the transmission process.

h). **Telco1 Ring:** One half of the balanced audio signal for line 1. (Input)

i). **Telco1 C1:** Incoming ring for line 1. Normally open relay contact which are closed (goes low) when ringing is present. one LS load. (Input) j). **Telco1 CBS1:** Anti-glare signal for line 1. Normally open relay contact. Goes low when line is seized by telco. One LS load. (Input)

k). **Audio1:** Bi-directional analog line from Matrix. AUDIO LINE 1

l). **Telco1 Tip:** Half of the balanced audio signal for line 1. (Input)

m). **Telco1 CS:** Line seize / dial pulse for line 1. Normally open relay contact, closed when line is seized. (Goes to ground) (Output)

n). **Telco1 CRV1:** Landline one disconnect. Normally open contact. Closed and grounded during a call. (input) One LS load.

o). **Telco1 Common:** Line 1 ground. (input)

p). **Tone Synthesizers:** Six tone synthesizers set up in pairs. Each consists of ; programmable time output, shift register with serial input and parallel output and an analog filter. Each tone pair will have two levels of gain.

Two main components consist of the Timers and Registers. The clock input of the register is driven at sixteen times the analog output freq. of the timers. Each synthesizer has three timers which can operate in various modes.

q). **DTMF Filter-Decoders:** Separate chips perform the filtering and decoding functions. U9, U14 and U19 are the filters.

When a tone input is received the filter chip splits the signal into separate low group tones (output on pin 1) and high group tones (output on pin 10). A "notch" in the filter rejects the dial tone.

These tone outputs are fed into the DTMF decoders (U10, U15 and U20) They will convert the high and low group tones into a binary output. The Tone Output Enable (TOE pin 9) level goes high after a valid tone pair has been detected. The decoder can be configured to detect either the digits 0 to 9 by pulling the inhibit line high (JU4, JU6, and JU8), **or** it can be used to detect all valid DTMF tone pairs by taking the Inhibit line (pin 12) low (JU3, JU5 and JU7).

r). **Input Latches:** Four input data latches (U3, U6, U12 and U16). These are connected to the processor data bus and read as though they were memory. Each chip is allotted $1000 of address space although only one unique address is needed for each chip. The latches bring the following signals to the processor; decoded output of the DTMF decoder, tone output enable and front panel enable/disable switch.

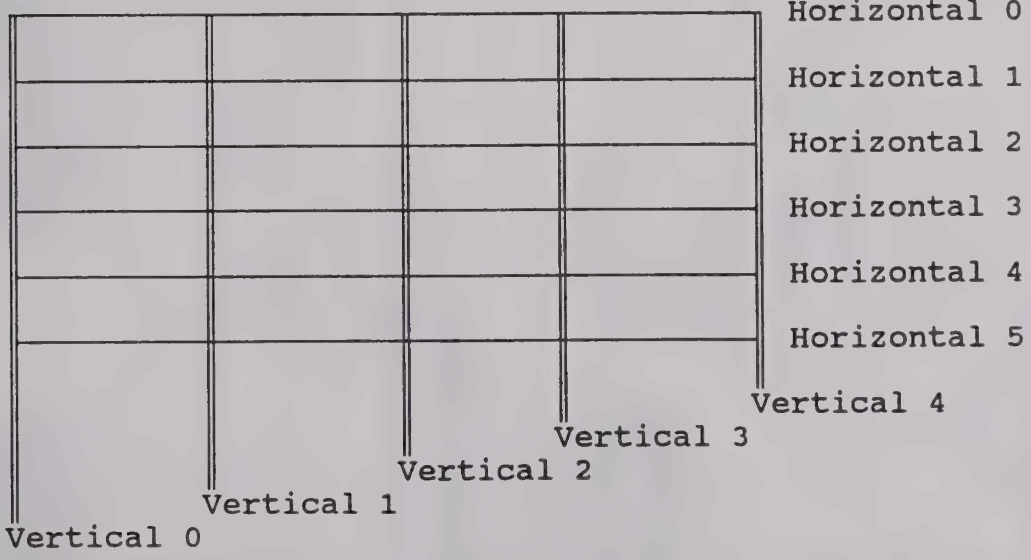
They interface with the Telco signals for the processor (audio, Landline disconnect, ringing and anti-glare).

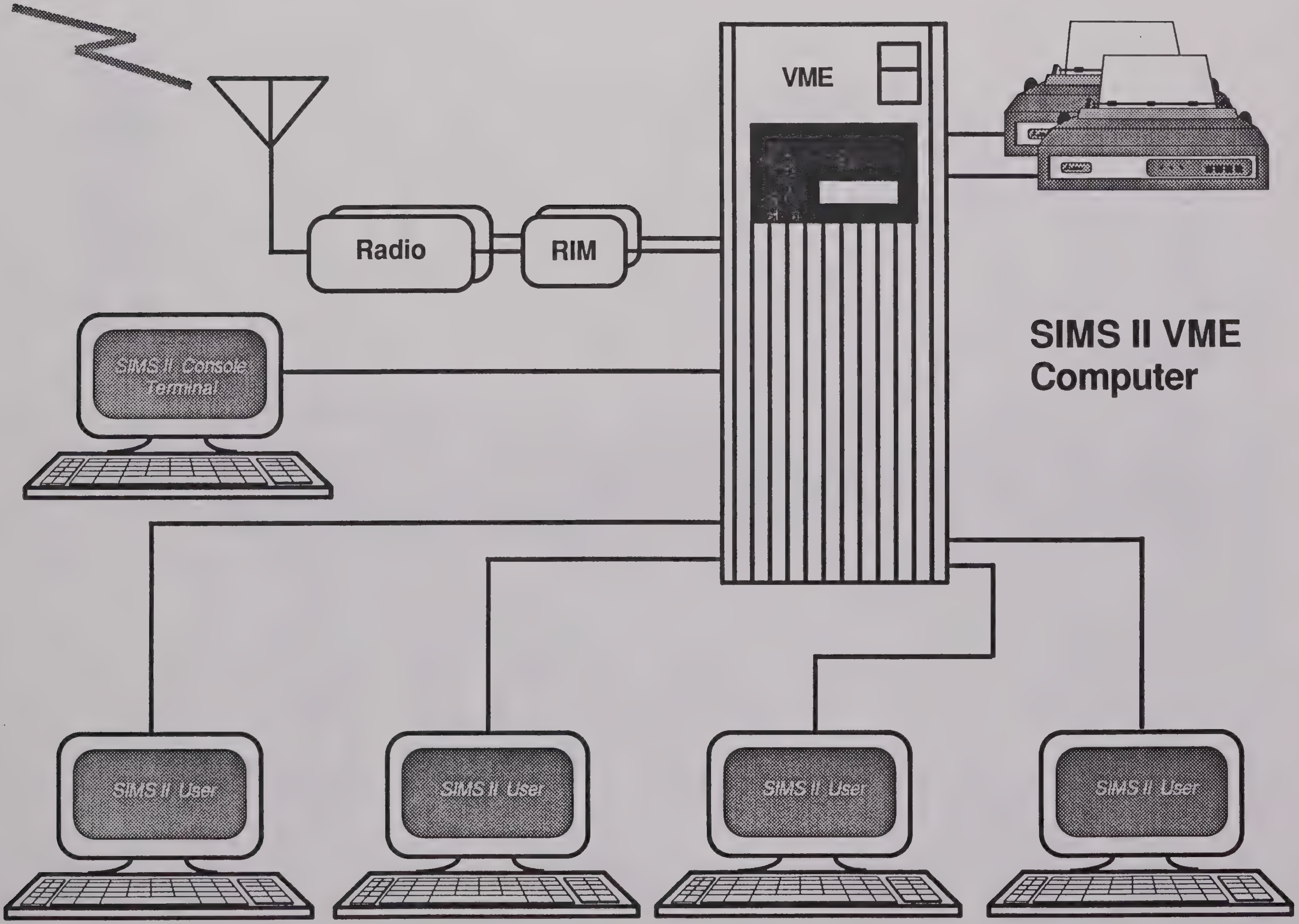
s). **Minor Matrix:** Each PLIB will contain what is known as the "minor" matrix. This matrix is composed of two IC's (U23 U24) they are both 8 X 4 switch array's.

Audio from the Matrix Board and the phone lines are brought in on the chips "horizontal's" and various other "resources" are connected to the "vertical's". These "resources" consist of the tone synthesizers, DTMF decoders, dial tone detector, trunking transmit and receive filters. Theses resources are connected to either phone lines or to the input audio signals (H1, H2, H3) through the matrix. The processor decides which lines are to be connected and it addresses the minor matrix through two data latches (U21 and U24).

The three address lines are used to select one of the "horizontal's and the data lines determine which vertical's on that horizontal are turned on. Each data line written high for a given horizontal is connected to all other vertical's, on a given horizontal, that are set high. Also, by enabling the same vertical on two separate horizontal's connects those vertical's together.

MINOR MATRIX


Horizontal 0
Horizontal 1
Horizontal 2
Horizontal 3
Horizontal 4
Horizontal 5
Vertical 4
Vertical 3
Vertical 2
Vertical 1
Vertical 0


VME
Radio
RIM
SIMS II Console Terminal
SIMS II User
SIMS II User
SIMS II User
SIMS II User

SIMS II VME Computer

II. Optional Peripherals

A. Smartnet Interface Management System (SIMS)

1. Description

    a. An optional component of a Motorola Trunked Radio System. Within the trunked radio system SIMS is a tool that allows SIMS dispatchers to initiate certain specific types of calls, send messages, perform control functions and monitor call traffic on a trunked radio system and provide dispatchers with certain additional capabilities not incorporated into the basic trunked system.

2. SIMS functions

    a. Visual monitoring of voice communications. - This monitoring involves the display of radio transmissions such as talkgroup calls, sub-fleet calls, private calls and several other types of transmissions.

    b. Controlling the dynamic function of specified radios. This involves a dispatchers use of commands such as regroup, cancel regroup, inhibit, and several others.

    c. Monitoring the dynamic function control of radios. - The basic logging feature in SIMS allows you to generate various reports to identify what radios and radio operations are being controlled by which dispatcher.

    d. Receiving change me requests and emergency alarms from radios. These two radio transmissions are messages from a radio operator to a dispatcher. A dispatcher responds to the change me message according to an established standard operating procedure. A dispatcher would respond to an emergency alarm according to a predetermined procedure.

e. Call alerting radios - A dispatcher can call alert a radio operator. When the radio operator receives the call alert, he or she is being notified to respond according to a predefined operating procedure. A call alert may be an attempt to get the attention of a radio operator who is not responding to voice communications from another radio operator.

f. Provide network manager interface. - The person or persons who are designated as network managers are responsible for setting up and maintaining the SIMS database. This database includes information that determines which dispatchers are responsible for which radios. There are a variety of ways to structure a dispatchers responsibility when setting up and maintaining the SIMS database. The network manager is also responsible for defining passwords to control access to various collections of database information such as radio entries, dispatcher entries, dispatcher responsibilities and much more.

3. SIMS additional capabilities

a. Selective radio inhibit

1). Purpose: To remove any potential threat posed by a missing radio, presumed in the hands of an adversary.

2). How It Works: Special command on trunked control channel, Closely similar to dynamic regrouping, Activates a "sleep" function instead of changing ID

3). Result:

   a). Radio receiver locked to control channel, but will only respond to individual clear command.

   b). Radio transmitter disabled

   c). All unit control (except power on/off) disabled

   d). All audio circuits muted

   e). Display/indicator off

   f). Inhibit state is locked in by nonvolatile memory in radio

4). Requirements: Target Radio Must Be:

   a). Turned on

   b). Within RF coverage range

   c). In a trunking mode (any)

   d). Monitoring control channel

b. Dynamic Regrouping

1). Individuals from different talkgroups may need to be brought together to communicate in the case of special situations. Regrouping is an important system control tool which allows the dispatcher or supervisor to change the talkgroup assignment of an individual radio to accommodate changes in communication needs.

2). The dispatcher or supervisor accomplishes regrouping by entering commands that are transmitted by SIMS or a standalone dynamic regrouping terminal to a radio via the control channel. Acknowledgement of completed regrouping tasks is displayed at the terminal. Indicators on individual radio units alert the user that they have been regrouped with four audible beeps. On display radios, talkgroup "X" will be displayed. From a radio with keypad activated talkgroup selection, a radio user can request to be cancelled from the regrouping mode by selecting talkgroup "R" and pressing the radio's PTT.

3). Regrouping assignments can be initiated rapidly, but not instantaneously. Radios to be regrouped must be turned on, in range and listening only to the control channel. Regrouping is best suited for preplanned activities or occasional changes from normal routines. It is not intended for immediate emergency responses such as found in high speed chases or for rapid deployments on a per incident basis.

c. Storm Plans

1). As a function of dynamic regrouping, a dispatcher can construct a regrouping storm plan in advance via a trunking terminal. When activated, the plan would automatically regroup certain specified radios into other talkgroups. This tool is well suited for disaster preparedness (in response to plane crashes, floods, hurricanes, or earthquakes) VIP visits, parades, etc. It allows the dispatcher to store a regrouping plan for critical situations and to appropriately change communication patterns.

B. Smartnet Control Management System (SCMS)

1. A variation of the SIMS system which is limited to a single user but does perform all SIMS functions and has all SIMS capabilities.

C. Smartnet Information Processor (SIP)

1. Description

a. A stand alone control and monitoring program for Motorola's Smartnet Trunking systems. It can be used by itself or in a system that includes more powerful terminal systems, such as SIMS.

b. General Information

1). The program is able to be ran on a IBM compatible PC and all radio and group information is stored in files on the hard disk. This same information is stored in RAM so that at least 640Kbytes of memory are required.

2). SIP is insensitive to case.

3). SIP works with TYPE I, TYPE II, and HYBRED systems.

4). Messages can be sent from SIP to a radio.

2. Features

a. Easy maintenance - SIP has extensive maintenance capabilities that allow a system manager to keep his/her system up-to date and to customize the display screens to best suit the system.

b. Alias names - Each radio or group can be assigned a unique name that can be displayed in place of the radio or group.

c. PTT Traffic monitoring - A radio dispatcher can monitor all push-to talk traffic on the system as it occurs.

C. SIP (Continued)

d. Print logging - All system activity or a subset of system activity can be printed automatically as it occurs.

e. Disk storage - All system activity or a subset of system activity can be stored in files on the hard disk for later use. These files are in ASCII format and can be viewed by word processors or loaded into some spreadsheet or database programs. Depending on how busy the trunked system is, activity can be stored for a period of a few days to several weeks. When your hard drive becomes full of these files, the oldest one is deleted before a new one is started.

f. Emergency alarms - A radio in a serious or emergency condition can alert the dispatcher by simply pushing a button on the radio. The dispatcher can identify the transmitting radio without requiring any voice communication. SIP can be configured to accept all alarms or emergency alarms from a subset of the radios.

g. Multiple systems - You can switch SIP between trunking systems with a few simple keystrokes. However, SIP can be used with only one system at a time.

h. Configuration saving - Whenever you change the configuration of your program, the changes are automatically saved in a configuration file. With this feature, if you exit the program or if it is interrupted by a power outage, it will always return to its last configuration.

i. Trunking system data bases - All radio and group information entered in SIP is automatically saved in databases on the hard disk. This information is automatically loaded by SIP whenever it is run.

C. SIP (Continued)

j. Help screens - SIP has an extensive set of help screens that allow an operator to obtain on-line help by simply pressing the F1 key. The help screens are keyed to the operation being performed.

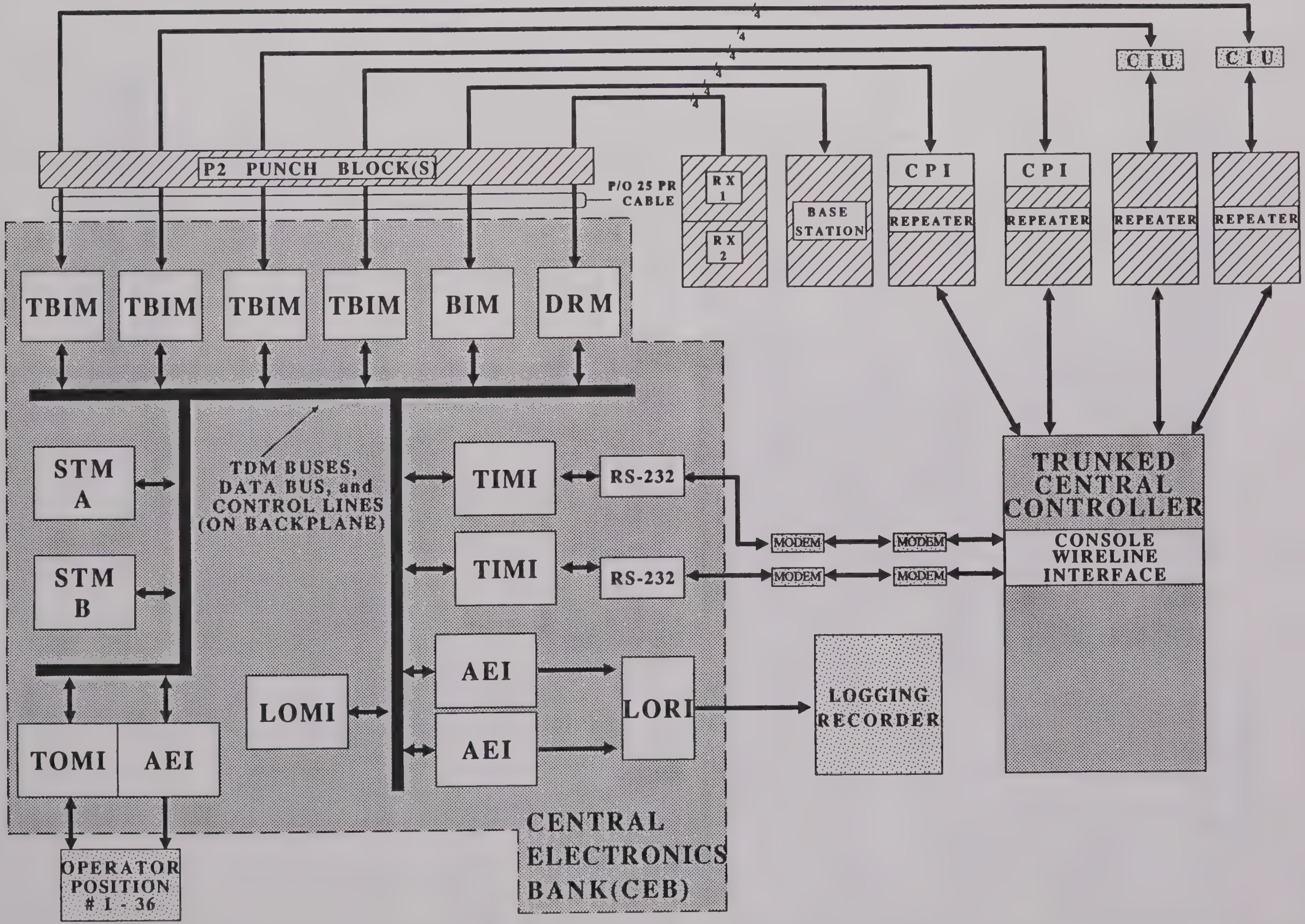
k. Reports - SIP will save and display reports on inhibited radios, regrouped radios, selector locked radios, and dynamic failsoft assignments.

l. Optional features that can be purchased and used as part SIP programming.

   1). Call Alert - Call Alert is used by a SIP operator to get the attention of a radio user who is not responding to voice communications.

   2). Selective Inhibit - Selective Inhibit stops the radio from operating. With this feature in effect, a radio user is not able to use the radio until a SIP operator makes it operational again.

NOTE: For Call Alert and Selective Inhibit SIP will attempt to contact a radio for a limited period of time. If the radio is off or outside the system coverage range, the chosen function will fail and the SIP operator will be advised of this fact.


4
4
4
4
4
4
CIU
CIU
P2 PUNCH BLOCK(S)
P/O 25 PR CABLE
RX 1
RX 2
BASE STATION
CPI
REPEATER
CPI
REPEATER
REPEATER
REPEATER
TBIM
TBIM
TBIM
TBIM
BIM
DRM
STM A
STM B
TDM BUSES, DATA BUS, and CONTROL LINES (ON BACKPLANE)
TIMI
RS-232
TIMI
RS-232
MODEM
MODEM
MODEM
MODEM
TRUNKED CENTRAL CONTROLLER
CONSOLE WIRELINE INTERFACE
AEI
AEI
LORI
LOGGING RECORDER
LOMI
TOMI
AEI
OPERATOR POSITION # 1 - 36
CENTRAL ELECTRONICS BANK(CEB)

TRUNKED CENTRACOM SERIES II SYSTEM ARCHITECTURE

D. Centracom Control Center Systems

1. Description

a. Centracom Consoles are fully featured dispatch control centers which can accommodate various numbers of dispatcher positions.

b. In addition to basic dispatch calling features , the consoles provide the following features and options:

1). Full duplex communications

2). Dual mode control: Ability to control trunked and/or conventional systems from the same console.

3). Console priority

4). Console diagnostics

5). Emergency alarm/call display

6). Single repeater merge for multiselect and patch

7). Tactical priority

8). Trunking central switches and indicators for control of redundant systems

9). Failsoft/idle indicator

10). Talkgroup repeat disable

11). Console redundancy

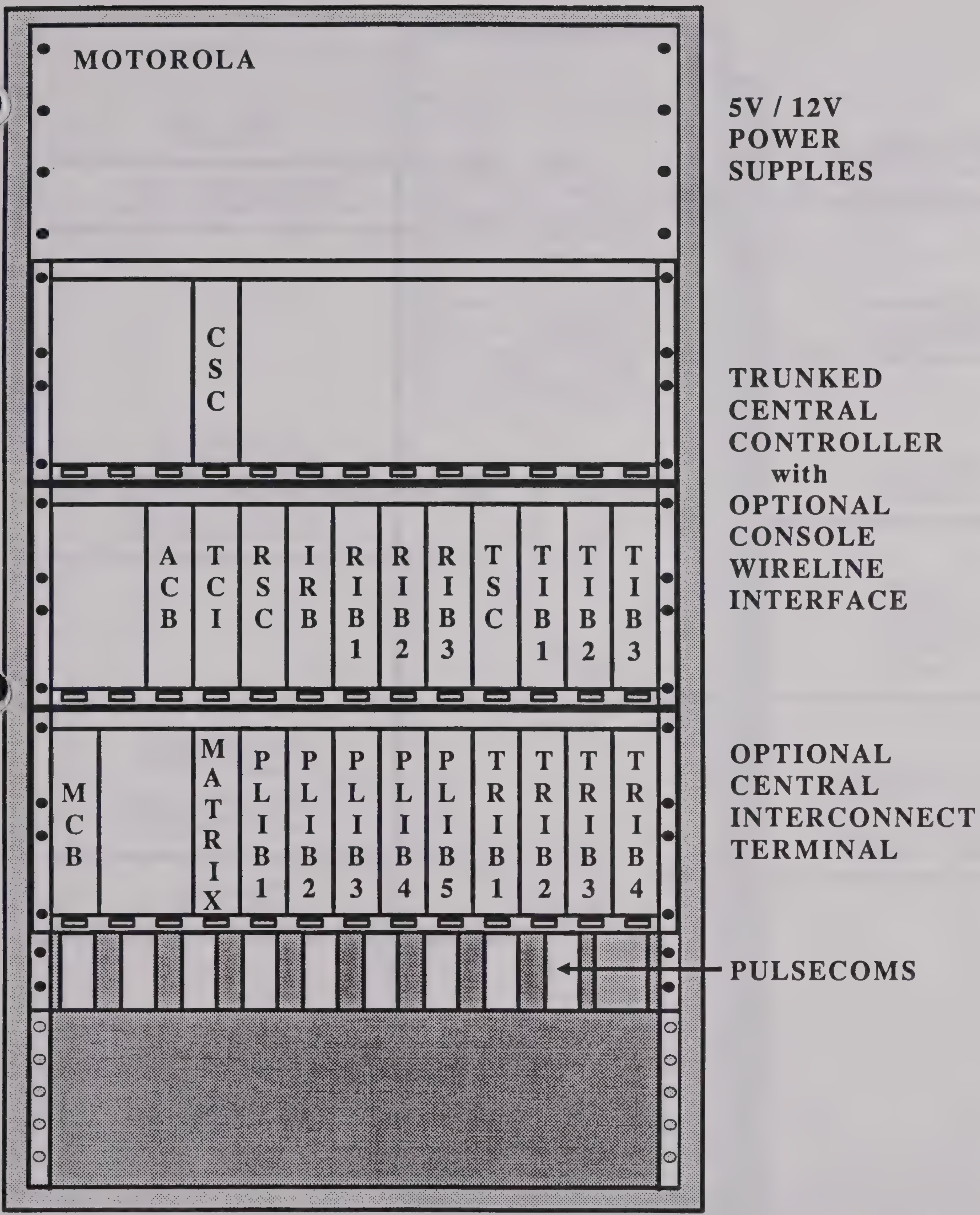
12). Secure voice control indicators

13). Private conversation capability

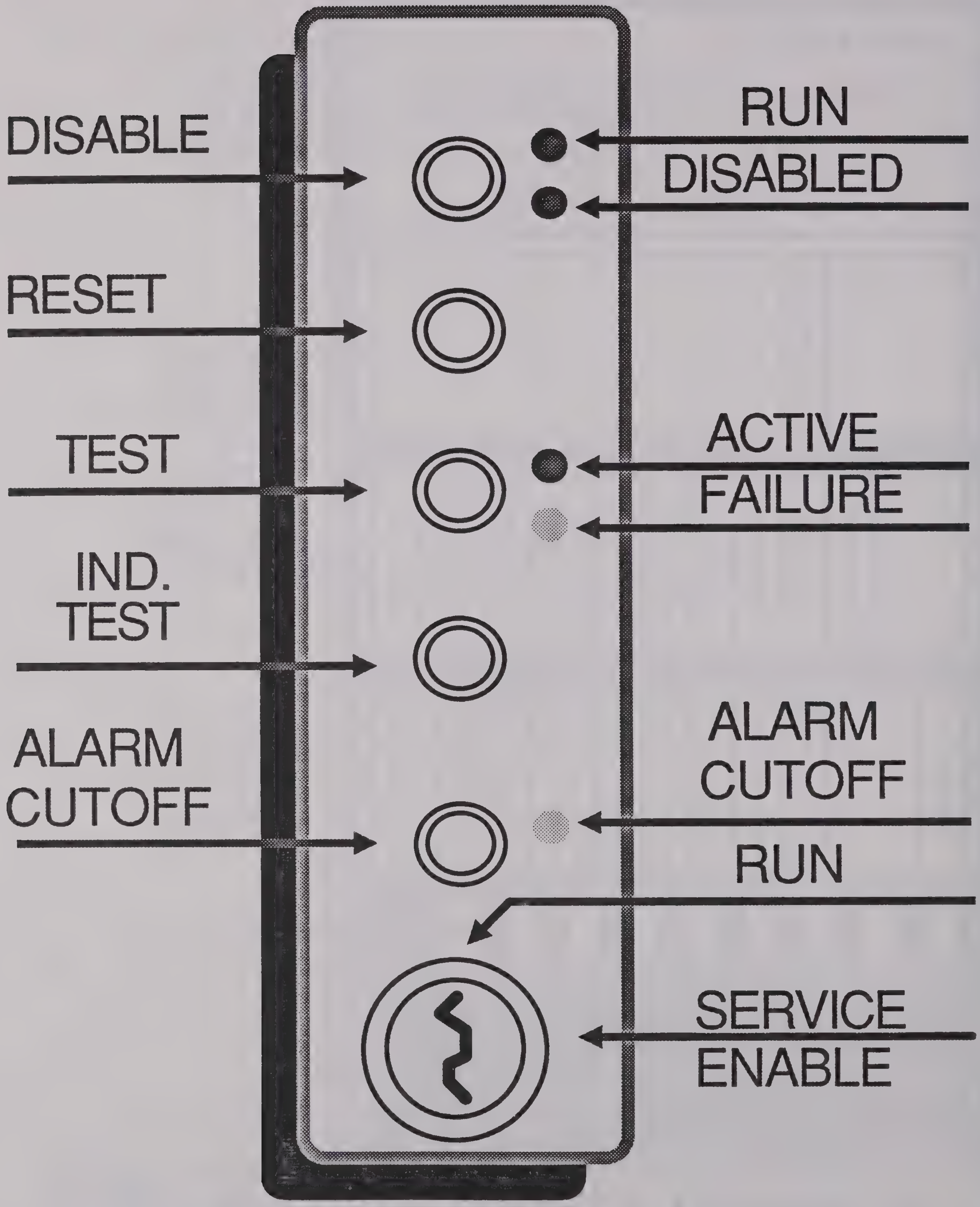
14). Preprogrammed private conversation/Call alert capability

15). Paging options

NOTE: Centracom console training is offered as a separate course.


MOTOROLA
5V / 12V POWER SUPPLIES
CSC
TRUNKED CENTRAL CONTROLLER with OPTIONAL CONSOLE WIRELINE INTERFACE
ACB
TCI
RSC
IRB
RIB 1
RIB 2
RIB 3
TSC
TIB 1
TIB 2
TIB 3
OPTIONAL CENTRAL INTERCONNECT TERMINAL
MCB
MATRIX
PLIB 1
PLIB 2
PLIB 3
PLIB 4
PLIB 5
TRIB 1
TRIB 2
TRIB 3
TRIB 4
PULSECOMS

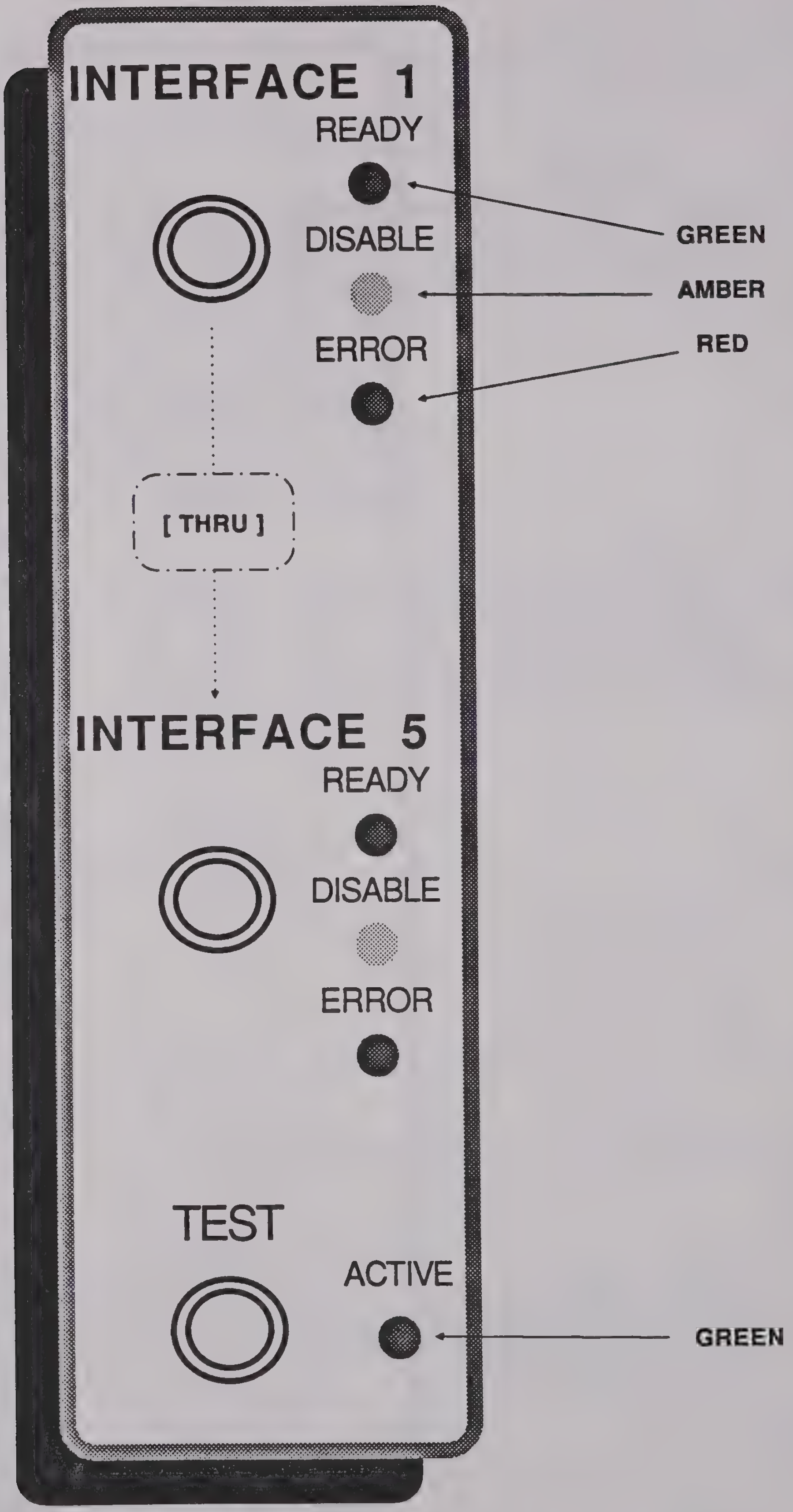
21 CHANNEL CENTRAL CONTROLLER
with CENTRAL INTERCONNECT TERMINAL
and CONSOLE WIRELINE INTERFACE


DISABLE
RESET
TEST
IND. TEST
ALARM CUTOFF
RUN
DISABLED
ACTIVE
FAILURE
ALARM CUTOFF
RUN
SERVICE ENABLE

TRUNKED CONSOLE INTERFACE

c. Trunked Centracom/Trunked Central Controller interfaces.

1). Trunked Console Interface (TCI) Board - The TCI board is inserted in the serial link between the Central Site Controller and Receiver Site Controller boards. This allows the trunked console to place call requests through the TCI, which appear to the CSC as valid call requests decoded by the RSC section. A listen only serial link from the TSC to the TCI provides an update to the console, via the ACB, as channel grants are issued from the CSC.


INTERFACE 1
READY
GREEN
DISABLE
AMBER
ERROR
RED
[THRU]
INTERFACE 5
READY
DISABLE
ERROR
TEST
ACTIVE
GREEN

ASYNCHRONOUS COMMUNICATIONS BOARD

2). Asynchronous Communications Board (ACB) - This board works in conjunction with the trunked console. The ACB interfaces with the console serially and puts the data in parallel format compatible with the TCI board. The board includes five asynchronous interfaces and receives address and data bus signals from the TCI board.

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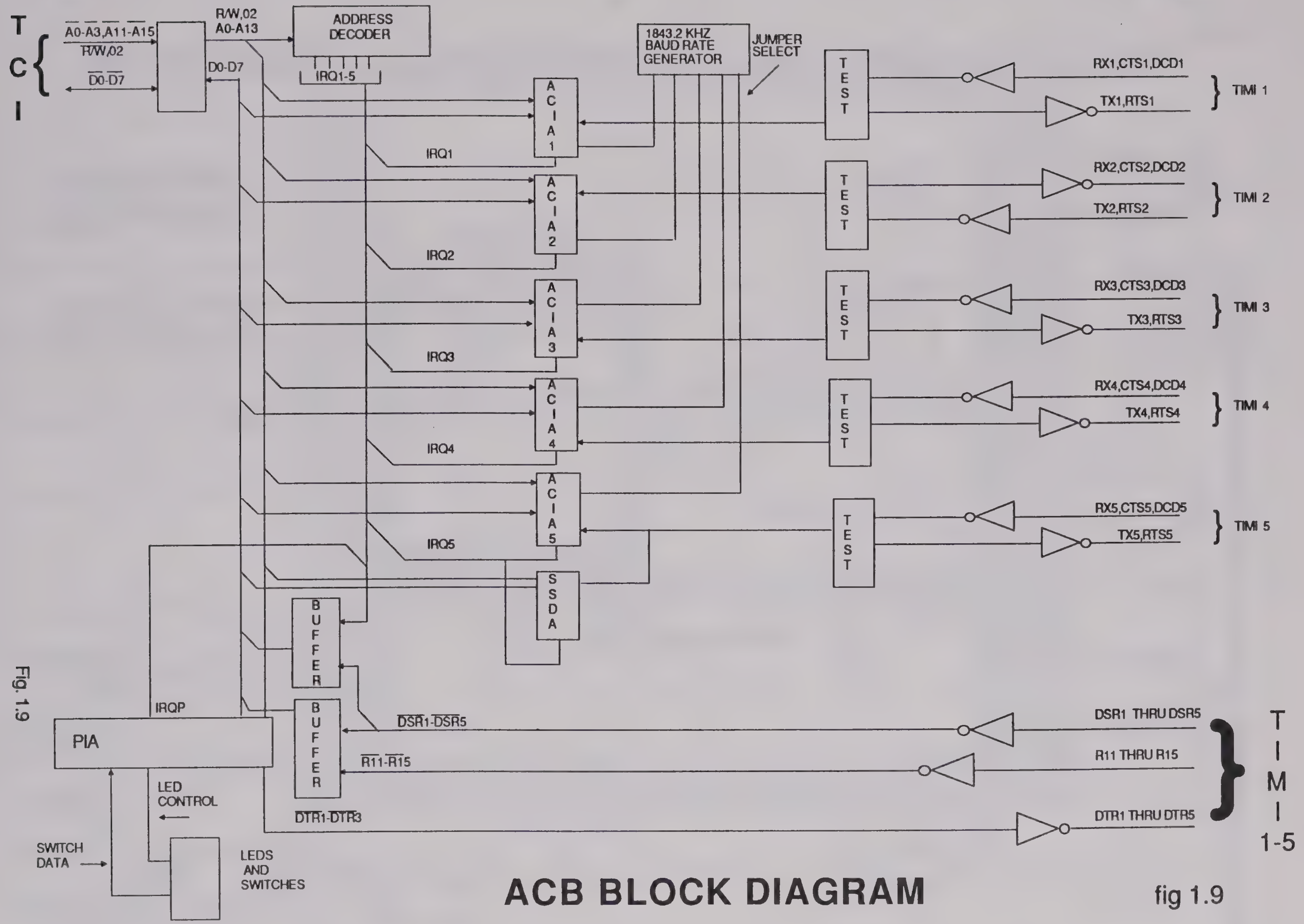
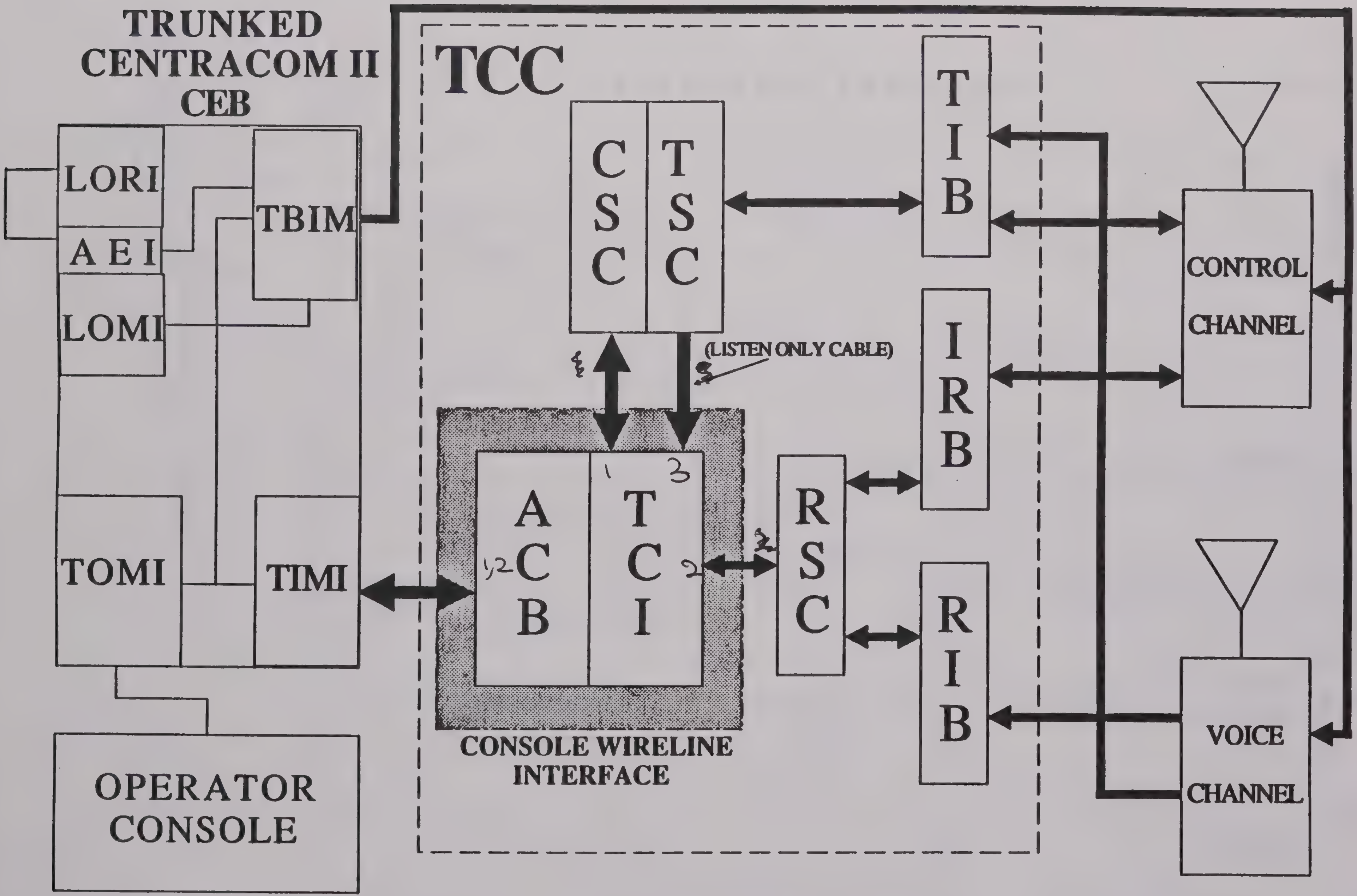

T
C
I
A0-A3,A11-A15
R/W,02
D0-D7
R/W,02
A0-A13
ADDRESS DECODER
IRQ1-5
D0-D7
1843.2 KHZ BAUD RATE GENERATOR
JUMPER SELECT
ACIA 1
IRQ1
ACIA 2
IRQ2
ACIA 3
IRQ3
ACIA 4
IRQ4
ACIA 5
IRQ5
SSDA
TEST
TEST
TEST
TEST
TEST
RX1,CTS1,DCD1
TX1,RTS1
TIMI 1
RX2,CTS2,DCD2
TX2,RTS2
TIMI 2
RX3,CTS3,DCD3
TX3,RTS3
TIMI 3
RX4,CTS4,DCD4
TX4,RTS4
TIMI 4
RX5,CTS5,DCD5
TX5,RTS5
TIMI 5
BUFFER
BUFFER
IRQP
PIA
DSR1-DSR5
R11-R15
DTR1-DTR3
LED CONTROL
SWITCH DATA
LEDS AND SWITCHES
DSR1 THRU DSR5
R11 THRU R15
DTR1 THRU DTR5
TIMI 1-5

ACB BLOCK DIAGRAM

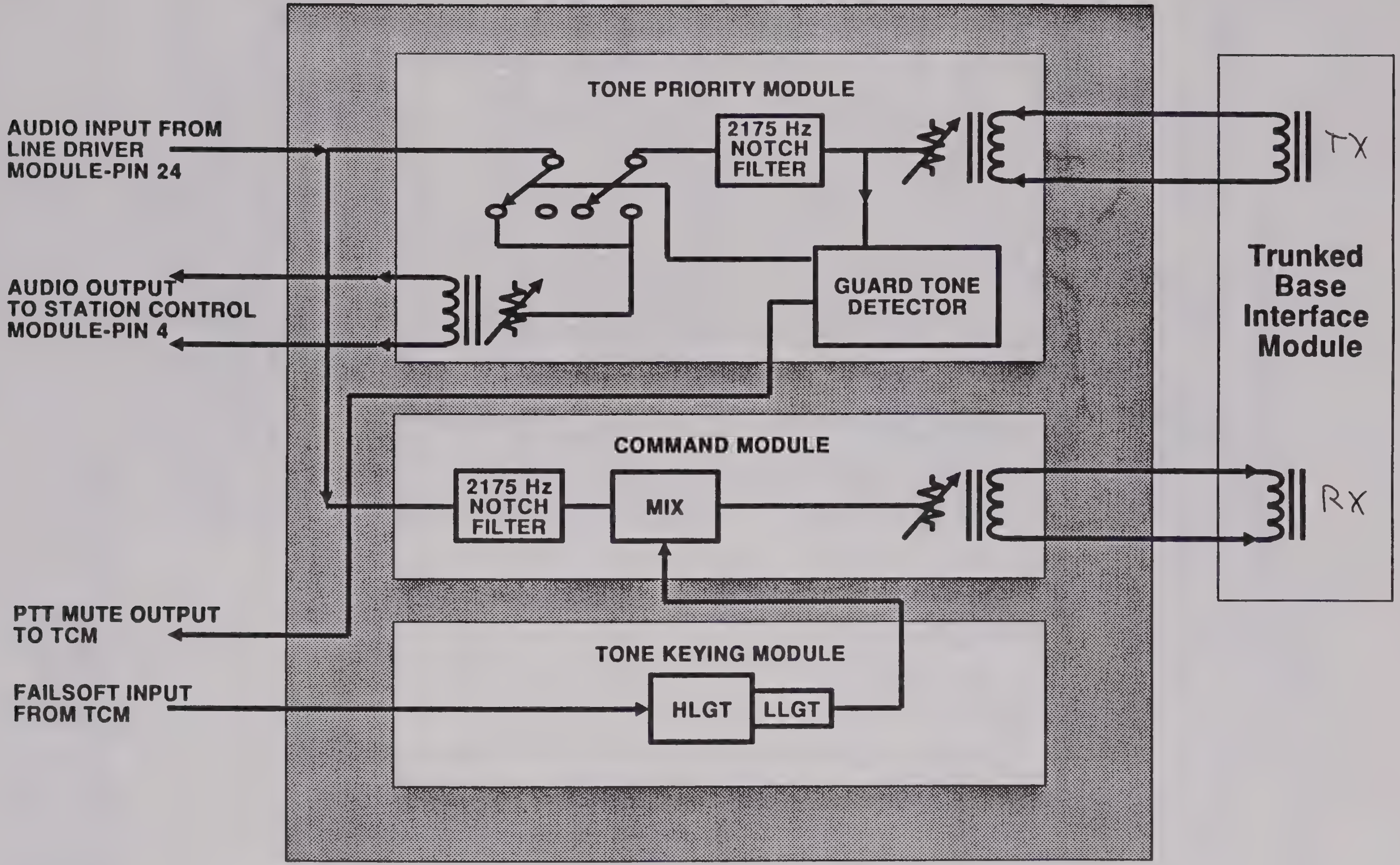
fig 1.9

Fig. 1.9


TRUNKED
CENTRACOM II
CEB
LORI
A E I
LOMI
TBIM
TOMI
TIMI
OPERATOR
CONSOLE
TCC
CSC
TSC
1
(LISTEN ONLY CABLE)
3
1
3
ACB
1,2
TCI
2
2
RSC
CONSOLE WIRELINE
INTERFACE
TIB
IRB
RIB
CONTROL
CHANNEL
VOICE
CHANNEL

CONSOLE WIRELINE INTERFACE TO TCC

Fig. 1.1.0


TONE PRIORITY MODULE
AUDIO INPUT FROM LINE DRIVER MODULE-PIN 24
2175 Hz NOTCH FILTER
TX
AUDIO OUTPUT TO STATION CONTROL MODULE-PIN 4
GUARD TONE DETECTOR
Trunked Base Interface Module
COMMAND MODULE
2175 Hz NOTCH FILTER
MIX
RX
PTT MUTE OUTPUT TO TCM
TONE KEYING MODULE
FAILSOFT INPUT FROM TCM
HLGT
LLGT

CONSOLE PRIORITY INTERFACE

3). Console Priority Interface

a). The **Console Priority Interface (CPI)** ensures that when a dispatcher "transmits" to any subfleet/talkgroup, the dispatcher's audio takes priority over any subscriber audio currently repeated on that channel. All members of that subfleet would immediately receive the dispatcher's audio, except the transmitting subscriber. Thus a dispatcher can interrupt current conversations without channel contention. Although not repeated, the current subscriber's audio is still routed to the console where it can be heard by the dispatcher. This prevents any vital subscriber information from being lost during dispatcher transmittions.

b). One **CPI** unit is required for each channel in a trunked system using **Micor** or **Analog MSF-5000 Base Station/Repeaters**. The **CPI** unit is located in the repeater. It consists of a **Tone Priority Module (TPM)**, a **Command Module (CM)** and a **Tone Keying Module (TKM)** in a Spectra Tac comparator cardcage. The Command Module is known as the Line Driver Module in the CPI unit.

c). The **Digital MSF-5000 Base Station/Repeater** has the **"CPI functions"** built into the **Trunked Tone Remote Control (TTRC)** board.

d). When the dispatcher talks on an assigned channel, 2175 Hz guard tone and transmit audio are sent from the channel's **Trunked Base Interface Module (TBIM)** to the **CPI**. The 2175 Hz guard tone is detected by a guard tone detector in the **TPM**.

e). The **TPM** opens the repeater receive audio path and passes the dispatcher's transmit audio to the transmitter. However, the repeater receive audio is still passed to the **CM** where it is amplified and passed to the **TBIM**.

f). The **TKM** is used when the repeater goes into failsoft. The **TKM** receives a logic level indication from the repeater's **Trunked Control Module (TCM)**. This causes the **TKM** to generate high and then low level guard tone which is passed to the **CM** and then to the **TBIM**. This is a vital part of the operation needed to put the **Trunked Centracom Series II** or **II+ Console** into the failsoft mode.

I. Diagnostics with Trunked Centracom Series II or II Plus

A. The Console Wireline Interface (TCI/ACB) provides the following diagnostic messages for Type I systems. These messages are not documented in the Type I System Manager's Terminal manual. They are found in the CWI/CPI manual (15S-SP3770170), Error Messages Tab.

TCI => DIAGNOSTIC MESSAGES FOR RSC 21 $$

F0 => warning - link failure detected from the TCI
** F1 => warning - unexpected device number in RSC EDM request
** F2 => warning - unexpected device number in TIMI EDM request
** F3 => warning - unexpected device number in CSC EDM request
** F4 => warning - unexpected EDM work
F5 => status - repeat EDM request from major device
F6 => status - repeat EDM request from minor device
F7 => warning - no response to first word ISW
F8 => warning - no first word recieved for second word ISW
** F9 => warning - unexpected channel command from the the CSC
** FA => warning - invalid channel work from the TIMI
** FB => warning - invalid OSW work
FC => status - established a link to a TIMI
FD => warning - lost one of the two TIMI links
FE => warning - lost both TIMI links
FF => warning - lost read only link to the TSC

** => Indicates that in these warning messages, the illegal data will be ignored by the microprocessor in the TCI

B. Daignostic 17 and <ESC> HT - Clear History of Trunking Subsystems

1. Clears the history of failsoft status to allow Central Controller to be re-activated following a TCSII / II Plus controlled switch to a redundant Central Controller.

2. Diagnostic 17 is entered via clock and keypad on TCSII or II Plus operator position.

3. <ESC> HT is entered via the diagnostic terminal.

4. After entering the command, the user then enters the console-trunked system ID (00,01,02, or 04) of the trunking system history to be updated. This clears the history flags for both subsystems of the entered trunking system.

E. SystemWatch

1. Description

   a. A stand alone diagnostic tool intended to display trunking system activity to the program operator.

   b. General information

      1). The program is able to be ran on a IBM compatible PC but requires a large amount of computer memory such that at least 640Kbytes of memory are required.

      2). SystemWatch is insensitive to case.

      3). SystemWatch works with TYPE I, TYPE II, and HYBRED systems.

      4). Messages can be sent from Systemwatch (snapshot feature) to a radio.

2. Features

   a. All screen - This screen displays all trunked system activities including push-to-talk traffic and channel busies. Activity is displayed as it occurs.

   b. Channel screen - This screen displays the current status of every channel in the system. The screen shows what group or radio is currently using each channel. Channel malfunctions are also displayed. The screen also displays the system's busy queue.

   c. User screen - This screen displays a select subset of system activity. You may select what type of activity and/or what groups or radios to view.

   d. Statistics - This feature compiles limited statistics on general system, channel, and group activity. Limited individual radio statistics are also available.

E. SystemWatch (continued)

e. Trigger - A system activity trigger can be set up to alert the SystemWatch operator when the specified system activity occurs. When the specified activity occurs, an alarm will be displayed on the SystemWatch screen.

f. ID calculator - This feature provides conversions between different radio and group ID notation methods. Printed lists of this information are also available.

g. Snapshot - A SystemWatch operator can inquire about the state of a particular radio including an indication if the radio is powered on. This feature is available for Smartnet TYPE II radios only.

h. Print logging - All system activity or a subset of system activity can be printed automatically as it occurs.

i. Disk storage - All system activity or a subset of system activity can be stored in files on the hard disk for later use. These files are in ASCII format and can be viewed by word processors or loaded into some spreadsheet or database programs. Depending on the activity level of the trunked system, activity can be stored for a period of a few days to several weeks. When your hard drive becomes full of this data, the oldest data is deleted to make room for new data. In this manner, the most recent data is always available for inspection.

j. Multiple systems - You can switch SystemWatch between systems with a few simple keystrokes. However, SystemWatch can be used with only one system at a time.

k. Easy maintenance - SystemWatch has extensive maintenance capabilities that allow a program operator to keep his/her system up-to-date and to customize the display screens and other program features to best suit the system or the customers mode of operation.

l. Configuration saving - Whenever you change the configuration of your program, the changes are automatically saved in a configuration file. With this feature, if you exit the program or if it is interrupted by a power outage, it will always return to its last configuration.

m. Help screens - SystemWatch has an extensive set of help screens that allow an operator to obtain on-line help by simply pressing the F1 key. The help screens are keyed to the operation being performed.

F. Data logger

1. Description

a. In a Motorola Trunked System, all transmissions are directed through a control channel, which assigns the mobiles to a specific repeater to carry out their conversation.

The Data Logger monitors this control channel and records the traffic that it handles. (If an exchange of transmission occurs on multiple channels, indicating that the operator let the voice channel repeater drop and was assigned another channel, the conversation is logged as multiple calls). Data logging can help identify callers who misuse the system and for system planning. Another feature of the Data Logger is to compile all calls in each fleet and print them out in a billing routine. This feature allows the user to view the total air time of each fleet.

2. **Call Message** explanation:

```
 1    2    3  4    5      6            7        8

403  040  01  P  0561 15:46:35.8  00:04.9  00:00.0
```

<u>**Explanation of Fields**</u>

a.	FLEET ID	The fleet ID is a 3 digit HEX number.
b.	UNIT ID	The unit ID is a 3 digit HEX number.
c.	SUBFLEET	The subfleet is a 2 digit DECIMAL number.

F. Data logger (continued)

d. CALL TYPE The call type field may be one of the following: (Indicates what occurred during a call)

CALL TYPE	DEFINITION OF RECORD
B	BUSY
C	CONTROL CHANNEL STATEMENT
D	DIAGNOSTIC MESSAGE
E	EMERGENCY
G	SUBFLEET OR FLEETWIDE CALL
I	INDIVIDUAL CALL
J	RINGING THE MOBILE
M	STATUS MESSAGE
P	PHONE CALL RECORD
R	INTERCONNECT REJECT
S	SYSTEM WIDE CALL
T	TRANSPOND
V	SOFTWARE VERSION NUMBERS
X	EXTENDED FUNCTION
Y	DYNAMIC REGROUPING

e. CHANNEL NO./ STATUS This number being less than 759 indicates a channel grant on the designated channel otherwise it is a status code.

f. TIME of GRANT Contains the time that a voice channel was granted.

g. GRANT TIME The amount of time that a user was assigned to a voice channel.

h. BUSY/STATUS TIME Indicates the amount of time that requestor had to wait before a voice channel was granted.

3. Channel or Status code explanation:

   a. The Channel or Status field always contains four decimal digits. On call types where a voice channel is granted, this field contains the channel number.

   b. On Interconnect, Busy, Emergency, Diagnostic, and other specialized calls, the field contains the appropriate status code.

F. Data logger (continued)

THE CHANNEL/STATUS FIELD CONTENT LISTING IS AS FOLLOWS:

CHANNEL STATUS FIELD CONTENTS	**DESCRIPTION**
0-759	CHANNEL GRANTS
768	SUBFLEET BUSY
769	INTERCONNECT BUSY
770	INDIVIDUAL BUSY (DUAL MODE)
771	EMERGENCY BUSY
779	EXTENDED FUNCTION (DUAL MODE)
780	INTERCONNECT STATUS
	SUBFLEET STATUS DESCRIPTION
	01 RING TO MOBILE (CONTROL STATION)
	02 RING TO MOBILE (CENTRAL)
	03 TRANSPOND REQUEST
783	INTERCONNECT REJECT
792	PAGING ALERT (HORN & LIGHTS)
793	EMERGENCY ALARM
813	SYSTEM WIDE CALLER ID
814	EMERGENCY ANNOUNCEMENT
928	DIAGNOSTIC MESSAGE
832-48	DYNAMIC REGROUPING ASSIGNMENT (17 STATES CORRESPOND TO 17 SIZE CODE MAPPING'S)
944	CSC SOFTWARE VERSION NUMBER

F. Data logger (continued)

4. LED DISPLAY

   a. The LED display panel shows the operator a graphical indication of system status. This display panel contains one red, one green, and twenty yellow LED's.

   b. The yellow LED's indicate channel status. A continuously lit yellow led indicates that the channel has been assigned by the central controller. A flashing yellow LED identifies the control channel or the test mode operation .

   c. The green LED indicates "busies" in the system. It will remain lit until all "busies" are terminated.

   d. The red LED indicates an unknown channel assignment.

5. Diagnostic Messages

   a. The "0928" in the Channel/Status field is used to indicate that this is a diagnostic command. The format of what is usually reserved for the ID field is:

      00P CDD 00

   b. Format explanation

      1). The "P" indicates the Port from which the command was receivedFor: --

         a). P = 1 TSC
         b). P = 2 RSC
         c). P = 3 ICU

      2). The "C" indicates the type of Command processed. For: --

         a). C = A ENABLE This means that the specified device is now enabled.

         b). C = C MALFUNCTIONED This means that the specified device is in the malfunctioned state.

F. Data logger (continued)

        c). C = E DIAGNOSTIC This means that the specified device is currently being diagnosed.

    3). The "DD" field contains the address of the specific device. The current list of devices is:

        a). $00-$14 Corresponds to RIB 1 through 21

        b). $20 RSC

        c). $40-$54 Corresponds to TIB 1 through 21

        d). $60 TSC

        e). $80 ICU

        f). $A0 IRB

        g). $E0 CSC

c. The primary use of these error messages is to provide information of a malfunctioning repeater, or if the CSC, RSC, ICU, or TSC are resetting.

G. System Manager's Terminal

1. Description

   a. The Motorola Trunked Radio System employs an interactive computer program that allows the system manager to use the system manager terminal to perform various functions such as: equipment and status alarm reporting; adjustment of the system timing parameters; channel activity status reporting; query the status of the trunked system base repeaters; enabling or disabling base repeaters; and modify, as desired, selected operating characteristics.

   b. The name of the interactive system control program is **GUARDIAN (GRD).**

2. Functions

   a. Equipment status and alarm reporting.

   b. Individual channel on/off capability.

   c. Adjustment of the system timing parameters.

   d. Channel activity status reporting.

   e. Date and time information entry for event testing.

   f. Entry of fleet to talkgroup affiliations.

   g. Adjustment of shared service algorithms.

   h. Interconnect activity status.

   i. Individual interconnect circuit on/off capability.

   j Entry of individuals on the positive subscriber list to selectively enable access to interconnect.

   k. Entry of airtime and TELCO billing parameters.

   l. Airtime and TELCO charge reporting.

m. Toll call records captured/displayed.

NOTE: Items i,j,k,l, and m above are only applicable to those systems that have telephone interconnect capability incorporated as an option to the system.

3. Hardware requirements

a. There are many different terminals that can be used with the system manager port. Motorola offers the TDN7010 terminal. Other manufacturers supply dozens of others. In addition to these terminals, it is also possible to use a personal computer (PC) running a communications package or a terminal emulator package. All of these terminals or PCs must use the standard ASCII character set.In addition, the terminal device should have the following characteristics:

1). Rate: up to 4800 baud (hard copy terminals are typically limited to 300 to 1200 baud)

2). Communications: RS-232-C link

4. General operating procedures

a. Access to system control program is through the use of five different "logons".

1). Each of the logon names has different command capabilities.

2). Each of the logons is "password" protected.

3). If an incorrect logon is entered three times the logon process is aborted and the system manager port will not respond for two minutes.

4). After a successful logon, if an incorrect password is entered five times, then the logon process will again be aborted and the system manager port will not respond for two minutes.

5). The initial action required to bring up the prompt for a logon is to strike the carriage return key one or more times.

6). At the GRD> prompt, and at most other subcommand prompts, the word "HELP" or "?" can be entered to obtain a list of all commands that can be performed by the LOGON that was used.

7). If no command input is made into a system for a period of five minutes after gaining access to the Guardian program, the system will automatically logoff the current user and display a "TIMEOUT" message. If another five minutes passes the and still no action is taken by the user then, then the program will display a "SESSION TERMINATED" message and the user must redial the SMT interface if he was operating from a remote dialup input.

8). Command input is NOT case sensitive but password input IS and must be exactly the same as established through the PASS command or the same as the defaults.

9). Command input in a lot of cases may be abbreviated and the minimum required is noted in the command summary in the system managers manual.

b. Logons

1). BILLING - used for those that will be downloading interconnect billing information. It will be afforded access to all billing listing type commands. While logged on under billing you cannot perform any operations under the SAC or other various commands.

2). CONTROL - used to perform the various SAC functions and to control usage of system resources. This the logon that will most often be used by the system manager. Performs all functions available to your system manager except the changing of passwords of another logon.

3). MASTER - The MASTER logon is used to access all system functions and has the ability to change the passwords for all of the other logons.

G. System Manager's Terminal (continued)

4). SYSTEM or SYSTXXXX - This is the logon normally used by service personnel. It is afforded all of the commands normally used to service systems. It is given access to all system functions required to analyze and maintain the system.
The contents of all system tables and authorization settings are visible. This logon can perform listing functions in any sub-system but will not be authorized to modify databases such as SAC. In other words it will not allow a SAC EDIT command to be executed. Also certain other commands are restricted in usage. The help command will list which sub-commands are available under each command.

c. Passwords

1). Passwords may be changed for a particular logon through the use of the PASS command under that particular logon, but may not be removed.

2). Passwords may be changed for all logons, when logged on as MASTER.

3). The older logon procedure for TYPE I systems which does not use password control for most commands may be emulated by setting the password to "NULL" for a particular logon. This can only be done when the individual acting as system manager is logged on under the MASTER logon.

4). The default passwords for various logons are:

a). BILLING	TRUNKING
b). CONTROL	TRUNKING
c). MASTER	$MASTER$
d). SYSTEM or SYSTXXXX	TRUNKING

5. Command Functions and Responses

NOTE: The following error messages may be seen in response to a command input:

1). INVALID COMMAND - The command entered was not found in the valid command table. Check spelling and proper form of command.
2). COMMAND NOT INSTALLED - The command was recognized as a known command from the tables, but the proper model and/or option has not been purchased and the necessary routines are not installed.

3). YOUR ID CANNOT USE COMMAND - The command is recognized, but the logon ID that was used is not permitted to use the command(i.e., BILLING trying to perform a SAC command).

a. AFFILIATE Command

1). Establish, change, or list talkgroup to fleet affiliations.

2). Not available for TYPE I only systems. Only used for TYPE II talkgroups, those on a TYPE II only system and those TYPE II talkgroups on a hybrid system.

3). Range of available fleet numbers is decimal 0001 to 4095.

4). Fleet numbers assigned for grouping talkgroups together and allowing designation of announcement groups. They have NO relation to TYPE I fleet numbers.

5). Talkgroup numbers always begin with T80 and have four more decimal digits that are the direct translation of the three digit hex number for a particular group. The range of talkgroup numbers is between 0001 and 4094.

6). A talkgroup number may only be affiliated with one fleet number. Under a fleet number, there can only be one group designated as the announcement group, for that fleet. Any number of talkgroups may be grouped together under the same fleet number.

7). Subcommands available:

a). Edit - Add/change/delete a talkgroup to a fleet.

b). List - List talkgroups associated with a fleet.

c). Clear - Clear entire affiliation table.

d). Stats - Status of talkgroup/ fleet affiliations.

e). Quit - Exit to GUARDIAN prompt.

b. EXIT/BYE Commands

1). EXIT and BYE commands terminate the user interface program (GUARDIAN).

2). To resume activity, the user must initiate logon procedures previously discussed.

3). If activity not resumed after five minutes, the system issues TIMEOUT and SESSION TERMINATED messages and disconnects the phone line if that was the means of system access.

c. CHAN Command

1). The CHAN command permits the systems to enable, disable, or check the current status of a particular channel or a group of channels. The CHAN command also allows the systems manager to display the shared user group channel mapping and to add and remove group from a particular channel or group of channels.

2). With current software you are no longer limited to working with a single channel at a time. Any subcommand may be executed for all channels or for an individual channel or for a range of channels.

3). Abbreviations that may be seen which indicate a particular status are:

  a). ENAB - Current device status is enabled.

  b). SW DIS - Current device status is switch disabled.

  c). SMT DIS - Current device status is system manager disabled (only RIB and TIB can be enabled and disabled from the system managers terminal).

  d). DIAG - Current device status is testing.

  e). MALF - Current device status is malfunction.

  f). DIS - Current device status is disabled.

4). If a RIB or TIB is currently disabled from the front panel and an enable request is invoked from the system manager terminal, the request does NOT override the switch position.

5). If a RIB or TIB is currently disabled from the systems manager terminal and the front panel switch is cycled from disabled to enabled, the switch position does NOT override the systems managers terminal.

6). If there is a call currently going on and a disable request is received by the CSC, the CSC ends the call within one minute or when carrier is no longer received, which ever comes first.

7). If the system is installed without an interconnect unit (MCB or ICU), the TRIB status is blank.

8). If the system is installed without a console (TCI), the TBIM status is blank.

9). Subcommands available:

a). S - Displays the STATUS of a particular channel or group of channels.

b). E - ENABLE a particular channel or group of channels.

c). D - DISABLE a particular channel or group of channels.

d). P - PROTECT a particular channel or group of channels.

NOTE: Protecting a channel is marking the channel so that the central will make it a last choice for servicing a call request. The central will only select a protected channel if all other unprotected channels that could satisfy the request are busy. Channels could be protected for one of the following reasons: to limit the impact of interference on certain channels, keeping a paging channel as free as possible, or, keeping a secure equipment channel as free as possible, and so on.

e). U - UNPROTECT a particular channel or group of channels.

f). G - Displays the status of the shared user groups for a particular channel or group of channels.

NOTE: Shared User groups are assigned to allow the system manager a means of control whereby individual units and talkgroups may be directed, or steered, to certain channels. For this purpose, all units and talkgroups are designated as part of a shared user group (eight possible assignments denoted by alphabetical characters A through H for both dispatch and interconnect call capability). Designations for individuals and groups are made in the SAC database but which groups are assigned to which channels is done in the CHAN command. Care must be exercised to avoid compromising the efficiency of the trunked system, and degrading service to the users but this feature can be used to steer call requests when there is some restriction on channel usage, such as public safety band channels on an SMR system, or when it is necessary to direct some subset of users to a channel or set of channels with special capabilities, such as secure voice or data. Critical shared user groups are those so designated, such that if all the channels assigned to that group are either disabled and/or malfunctioned (not just busy) the group will be assigned any other channel that can support the type of call requested.

g). A - ADD one or more shared user groups to a particular channel or group of channels.

h). R - REMOVE one or more shared user groups from a particular channel or group of channels.

i). Q - QUIT, exits to the GUARDIAN prompt.

d. DATE Command

1). The DATE command allows the system manager to query and/or modify the date and time of the system clock. Date and time are used by the system for a) diagnostics, b) alarm reporting, and c) interconnect call processing and billing.

2). First the date is presented for correction and then the time.

3). Formats:

a). Date = DOW_MM/DD/YR where:
DOW = Day Of Week (Sat - Sun)
MM = Month (01 - 12)
DD = Day (01 - 31)
YR = Year (00 - 99)

b). Time = HH:MM:SS where:
HH = Hour (00 - 23)
MM = Minute (00 - 59)
SS = Second (00 - 59)

4). The day of the week specification is required for interconnect call processing purposes. A space is required between the day of the week and the month specifications.

e. DIAG Command

1). The DIAG command controls how error messages are presented. If the mode is set to "MANUAL", messages are seen by calling the DIAG processor, using the PRINT command, and purging error messages with the CLEAR command. If the mode is "AUTOMATIC", error messages appear automatically whenever the system manager terminal is connected to the trunked system.

2). In the automatic mode error messages are printed and purged as they are generated, whether the system manager terminal is actually logged on or not. Unless a printer is constantly on line to print whatever comes up on the system manager monitor, the diagnostics not physically seen will be lost.

3). In the manual mode, the print command is required to display diagnostics. This is a non-destructive print and the error messages can be printed over and over again. Any new error messages generated will be added to the error message queue and printed out at the next print command. If the error message queue should become full, the oldest message will be deleted to make room for the new. Any messages dumped in this manner prior to printing are lost. The CLEAR command flushes the error message queue and all messages are lost.

4). Subcommands available

- a). Automatic - Turns on automatic error message reporting system.
- b). Clear - Clears all error messages from memory.
- c). Manual - Turns off automatic error message reporting.
- d). Print - Prints stacked error messages.
- e). Quit - Exits to GUARDIAN prompt.

f. PARM Command

1). The optional PARM command provides the ability to modify, within prescribed values, selective system timeout periods. The command function has been enhanced to include specification of the number of consecutive assignments of a talkgroup to recent user queue.

2). Parameters available for modification:

a). Carrier Time-Out Period - Determines the time period for which an assigned voice channel remains unmuted and active, receiving only carrier and no handshake connect tones. After time-out expires, the channel assumes the disconnect phase. The timer can be activated after disconnect tone is detected by the central controller.

b). Fade Time-Out Period - Determines the time period for which an assigned voice channel remains active with no tones or carrier received. After the time-out expires, the channel is de-assigned. Timer is activated after the central controller fails to detect disconnect tone after loss of the low speed connect tone.

c). Message Trunk Time-Out Period - Determines the time period for which a voice channel remains active after receiving disconnect from the subscriber unit (repeater dropout time). After the time-out expires, the channel is de-assigned.

d). Carrier Malfunction Time-Out Period - Determines how long an interfering carrier must be present on a de-assigned channel before that channel is removed from system use. An entry of 254 seconds disables the time-out.

e). Recent User Assignments - Defines the maximum number of consecutive assignments of a talkgroup to the high priority recent user queue. This number can be adjusted to achieve an acceptable balance between message continuity and the monopolization of the system by a large user group.

f). Link Time-Out to Remote Site - Determines the time period the DCB waits before malfunctioning a remote site. This is a function for simulcast operation.

g). Minimum Failsoft Time - Determines the time period the system stays in failsoft after all conditions have been met for trunking.

3). To change a particular parameter.

a). The LIST subcommand is used to examine the various parameters.

b). A parameter is changed by entering the particular subcommand for that parameter using its designated abbreviation and then a space followed by the new value.

4). Subcommands available:

a). Carrier - Carrier time-out period. Range 0.1 - 6.3 seconds. Default = 0.5

b). Fade - Fade time-out period. Range 0.1 - 6.3 seconds. Default = 1.2

c). Trunk - Message trunk time-out period. Range 0.1 - 6.3 seconds. Default = 1.0

d). MAlf - Carrier malfunction time-out period. Range 1 - 253 seconds. Default = 50

e). Recent - Recent user assignments. Range 0 - 255 assignments. Default = 2

f). LINk - Link time-out to remote site. Range 15 - 99 seconds. Default = 15

g). MF - Minimum failsoft time. Range 0:10 - 25:00 minutes/seconds. Default = 0:30

h). **LIS**t- Displays the currently chosen values for all parameters in the system.

i). Quit - Exits to the GUARDIAN prompt.

g. PASSword command

1). After a user logs on to the system, the user can change the password on that account. In the case of the MASTER logon only, passwords can be removed or changed for all logons.

2). To access the password command enter "PASS" at the GRD> prompt. To prevent an unauthorized individual from walking up to a logged-in terminal and changing the password for the account, the current password for the account is requested. After this is entered and verified, you are prompted for the new password. This new password can be composed of 4 to 8 upper or lower case alpha characters, numbers, and the special characters that appear normally in the upper case positions on most keyboards. Punctuation and control characters are not permitted. If syntax requirements are passed, you are then prompted for the new password again. The two password inputs are compared, and if the same, become the new password.

3). Passwords are not displayed to the system manager terminal. Note that the password is case sensitive, so if you change the password using lower case characters, it must always be entered the same way, namely, in lower case.

4). If the PASS command is issued by the MASTER logon, the user is prompted for the logon to be changed. One of the four valid logons should then be entered. Then the system prompts for the passwords. Also, the MASTER logon alone can disable the password for any of the logons by changing the password for that logon to "NULL" (this must be in upper case).

NOTE: The password for SYSTEM logon applies also to the SYSTXXXX logon.

5). In order to afford the highest level of security, the password is not kept in memory in a readable form. Once the password is established and verified, it is then processed by a one-way algorithm to produce a bit pattern that is then stored in memory. It is then later compared to logon passwords entered. If the bit patterns match, the password entered is accepted. If they do not match, then the user is not allowed access to the system.

6). If a user forgets the password, it cannot be retrieved from memory. The MASTER logon can change the password, but cannot determine what the current password was. If the MASTER logon password is forgotten, that account can no longer be accessed unless the system is powered down and battery-backed RAM erased by pulling the battery jumper (JUVB+).

7). Even though the MASTER logon password may be lost, all other logons can still be used as long as the passwords for those accounts are known.

8). A number of messages are shown in the system manager manual to prompt input and/or show errors detected in the changing of passwords. The explanation given and/or recommended action will insure password changes are accomplished correctly.

h. SAC command - subscriber access control

1). The SAC command gives the system manager control of the manner in which his system may be accessed by individual subscribers. This control is exercised by determining which, of all the possible, individual and group ID's are going to be allowed to be active on the system.
Also by controlling what specific types of calls and/or characteristics the individual and group IDs may be allowed to make and/or have. In addition systems may be either positive or negative subscriber access depending upon the requirements and desired method of control of the person/company/agency purchasing the system.

a). Positive subscriber access - Under this method of control, when the system is first powered up and no further action is taken by the system manager, all IDs available are denied access until such time as the system manager activates the subscriber access database and also activates those individual IDs that he has authorized to use the system. If for any reason the subscriber access database is deactivated then no IDs (radios or other system users) will be allowed to communicate on the system. Only individuals IDs can be activated or deactivated on a system. This may be accomplished one individual at a time or it may be done by fleets for TYPE I IDs or by ranges for TYPE II IDs. Subfleets/talkgroups IDs are always considered active on the system.

b). Negative subscriber access - Under this method of control when the system is powered up and the system manager takes no further action, all IDs that are available on the system will be authorized to make calls using the default parameters selected for the system and incorporated in it's codeplug. This means that to deny an ID use of the system, that first the subscriber access database must be activated on the system and then individual subscribers may be deactivated. Subfleet /talkgroup IDs are always considered active and only individual IDs may be activated and deactivated on the system.This may be done individually or as a fleet for TYPE I IDs or as a range for TYPE II IDs. If for any reason the subscriber access database is deactivated then any ID may again use system resources.

NOTE: With either positive or negative subscriber access the deactivation of an ID removes it so that it cannot even be listed, such that if the system manager wishes to temporarily remove an ID from service he should disable not deactivate. Also when an ID is re-activated it's characteristics are set to default, such that any changes for that particular ID are lost.

2). Individual ID attributes:

a). ENA - (Enable) - Y indicates that the individual is allowed to use the system when the Subscriber function is active. The system uses the default records when the Subscriber function is inactive.

b). EP2 - (Enhanced Protocol II) - Y indicates that the individual does not perform high speed handshake. For TYPE II units, this flag will always be set, and, cannot be modified since these units never perform high speed handshaking.

c). FIX - (Fixed Location) - Y indicates that the individual has a fixed location, such as a console. N indicates that the individual has a mobile location.

d). AMS - (Automatic Multiple Site Switching) - Y indicates the an individual is allowed to make a wide area (AMSS) call. This feature is used only from the RCSC when there are wide and local channels.

e). PRL - (Priority Level) - Priority levels (2-8) (2-5 for SMARTWORKS models) can be set in allocating system resources to the unit. In the case where the unit and talkgroup have different priorities, the central controller will use the higher priority (lower number). Priority applies to both dispatch and interconnect calls.

f). SYW - (System Wide) - Y indicates the unit is allowed to make a system wide call. The unit must be equipped with the system wide call option.

g). MGC - (Multi-Group Call) - Y indicates that the unit is allowed to make multi-group (fleet-wide/announcement) calls.

h). TGW - (Talkgroup Wide) - Y indicates that the unit is allowed to make a talkgroup wide call.

i). PVC - (Private Call) - Y indicates the unit is allowed to make a private call. The unit must be equipped with one of the private call options.

j). INT - (Interconnect Call) - Y indicates the unit is allowed to make a telephone interconnect call. The unit must be capable of making an interconnect call and must be on the authorization list if it is active.

k). DRG - (Dynamic Regrouping) - Y indicates that the unit is allowed to initiate dynamic regrouping commands (open gateway). Selective Radio Inhibit feature is always enabled for all users and is not controlled by the DRG field.

l). 821 - (821 Mhz capable) - Y indicates that the subscriber can synthesize 821 Mhz frequencies.

m). PAG - (Paging Request) - Y indicates that the unit is allowed to make a paging request.

n). DAT - (Data Request) - Y indicates the unit is allowed to make a data request.

o). SEC - (Secure Communications) - N (Normal) indicates that the talkgroup is allowed to make clear (non-coded) calls only. S (Secure) indicates that the talkgroup can make secure (coded) calls only. B (Both) indicates that the talkgroup is allowed to make both clear and secure calls.

p). SHU - (Shared User) - Individual users are grouped into one of eight shared user groups (A-H). Five channel requests are steered to Shared User Group A.

3). Talkgroup attributes:

a). ENA - (Enable) - Y indicates that the talkgroup is allowed to use the system when the Subscriber function is active. The system uses the default records when the Subscriber function is inactive.

b). MFL - (Mixed Fleet) - Y indicates that the fleet is mixed (contains TYPE I and TYPE II IDs). N indicates TYPE I IDs only. This option is used for TYPE I fleet-subfleet records only, and is only editable on a fleet basis.

c). PMG - (Priority Monitor Group) - Y indicates that the talkgroup is a priority monitor group.

d). AMS - (Automatic Multiple Site Switching) - Y indicates that a talkgroup is allowed to make wide area (AMSS) call. This feature is used only from the RCSC when there are wide area and local channels.

e). PRL - (Priority Level) - Priority levels (2-8) (2-5 for SMARTWORKS models) can be set in allocating system resources to the talkgroup. In the case where the unit and talkgroup have different priorities, the central controller uses the higher priority (lower number). Priority applies to both dispatch and interconnect calls.

f). PR2 - (Normal/Tactical Priority Level) - Normal or tactical priority levels can be set through a console in assigning system resources to the talkgroup. Y indicates that the talkgroup is set to tactical priority (priority level of 2). N indicates there is no tactical priority level. Normal/Tactical priority changes can be made through a console and do not apply to the default record.

g). PTI - (Push-To-Talk ID) - Y indicates that the talkgroup operates using PTT ID. This option is used for TYPE I fleet-subfleet records only and is only editable on a fleet basis.

h). 821 - (821 Mhz capable) - Y indicates that the talkgroup can synthesize 821 Mhz frequencies.

i). SEC - (Secure Communications) - N (Normal) indicates that the talkgroup is allowed to make clear (non-coded) calls only. S (Secure) indicates that the talkgroup can make secure (coded) calls only. B (Both) indicates that the talkgroup is allowed to make both clear and secure calls.

j). SHU - (Shared User) - Talkgroup users are grouped into one of eight shared user groups (A-H). Five channel requests are steered to Shared User Group A.

4). Default records - If the data for a particular unit is lost, the system will replace the data with the appropriate default record. These records, one for individuals, one for talkgroups, have all the attributes assigned to either an individual or a group on a system. They can be operated on, i.e. modified, by specifying "I*" for individuals or "T*" for groups.

This allows the system manager to specify what grade of service a user will receive if his record is lost. It also allows the default records to be modified so they can be used with certain subscriber subcommands, such as CLear and SET. If the default records are lost, then the system replaces them with default records stored in the central controller codeplug. The codeplug default records are programmed in the factory.

5). Modification of the SAC database is accomplished by first entering a correct entry in the command and ID field. This specifies the action to be taken and designates those IDs to be acted upon. The specific ID(s) format is dependent on the type of system (TYPE I, TYPE II, or Hybrid) and for a hybrid system, what section of the fleet-map/individual-ID area of memory you are working in (cannot manipulate data for ranges of IDs that start out as TYPE II and then change to TYPE I or vice-versa). ALso instead of changing a specific ID you can change the defaults for all IDs by using "I*" for individuals or "T*" for groups.

After having made a correct entry in the command and ID field, the system manager may now make any modifications to one or more attributes by entering a ";" and then,in the options field, the three character designation for the attribute to be changed, followed by an "=" and then the desired change for that attribute. The available choices for a particular attribute and which attributes are permitted to be modified can be accessed through the OPTions subcommand. More than one attribute may be designated for change by placing a "," between them, but once an attribute is specified for change it cannot be specified for change again in the same entry's option field under the command and ID field being used for that entry.

Also an individual or group record can be set to default by entering the correct ID followed by an "*".

6). Subcommands available

a). Options - This subcommand prints the abbreviations for the user attributes that the system manager is allowed to modify, along with their associated values that can be set.

b). Activate - This subcommand is used to put an individual in the active records list. When a record is activated, it gets the same attributes as the default record. For TYPE I, if an entire fleet is activated, or for TYPE II, if a range of individuals is activated, then the system asks "ARE YOU SURE(Y/N)?" before continuing. The default record is set active by specifying "I*" instead of an individual ID.

c). Deactivate - THis subcommand is used to remove an individual from the active records list. When a record has been deactivated, it can no longer be listed, modified or used until it is activated again. The default record can be deactivated by specifying "I*", however, it can still be listed but not modified. Deactivate also asks "ARE YOU SURE (Y/N)?" when an entire fleet is deactivated for TYPE I or a range of individuals for TYPE II.

d). Edit - This subcommand changes the SAC attributes for any individual record, fleet-subfleet/talkgroup record, individual default record, or fleet-subfleet/talkgroup default record. After a single record is modified, the record is listed to confirm the change.

If the EDIT is for an entire fleet in TYPE I, or a range of records in TYPE II, the system asks "ARE YOU SURE (Y/N)?" before proceeding. Individual records may only be modified if they are active.

e). LIst - This subcommand displays any record or related group of records. Like the EDIT subcommand, LIST has two parts to its input field. If the ID field is blank, all the individual records are listed. If all individual records, an entire fleet for TYPE I, or a range of records for TYPE II is requested, the option field can specify that only records with certain attributes be listed. The option field has the same syntax as the EDIT subcommand. Individual records may only be listed if they are active. The default records, both individual and fleet-subfleet/talkgroup, can be examined by specifying "I*" and "T*" respectfully. If a list of all records is requested, a form feed character is sent before each 56 IDs. Typing **control-X** at any time stops a LIST subcommand and returns the system to the SAC prompt.

f). STats - This subcommand has a dual function. First, if any records have been lost and set to default, STATS reports it by printing the lost IDs. Second, it always reports the state (active/inactive) of the SAC system and asks if it should be changed. Both TYPE I and TYPE II IDs are reported with the same command. If more than 255 records have been lost, STATS reports "ALL SUBSCRIBER RECORDS HAVE BEEN SET TO DEFAULT".

g). CLEar - The CLEAR subcommand places all SAC records into a known state. When this subcommand is entered, the default values for subscriber records stored in the code plug are copied into the default records. The default records are then copied into all SAC records. Once all records have been "cleared", the individual default record is activated and the SAC status is set to inactive.

NOTE: The CLEAR subcommand should be performed, followed by the SET subcommand, after the CSC board has lost power for an extended period of time. This is because all subscriber records will have been lost (as reported by the STAT subcommand) and should be initialized to a known state.

h). SEt - The SET subcommand also places all SAC records into a known state. When this subcommand is entered, the default values for subscriber records are copied into all SAC records and the SAC status is set to inactive.

i). CSave - The CSAVE subcommand causes the central controller to send a copy of memory to a recording device.Execution of this subcommand requires an intelligent storage device. A System Manager's Terminal (SMT) node is needed on the intelligent end. CSAVE allows an error free saving of the data without the need for verification or repeated attempts to save data. The CSAVE subcommand is designed to save talkgroups, talkgroup-to-fleet affiliations, and only those individual records that the manager has ACTIVE on the system. Therefore, it is very important that the manager DEACTIVATE any individual records that are not being used to reduce the time taken to perform this subcommand (up to 1 hour and 50 minutes with no records deactivated).

j). CLOad - The CLOAD subcommand causes the central controller to read data from an intelligent storage device, check the data received, and, if valid, place this data into memory at the proper location. An SMT node is needed on the intelligent. CLOAD allows an error free loading of data without the need for repeated attempts to load the data. The subscriber function is set to inactive whenever the CLOAD subcommand is used.

k). Quit - Exits SAC and returns back to the GUARDIAN prompt.

7). Within the subscriber software package are routines designed to detect errors in the subscriber data base. If a record is found to be bad, it is set to default and marked as lost. The system then sends the appropriate diagnostic message, stating that some data was lost. The system manager should then use the STATS subcommand to see what records were lost so they can be corrected. The system keeps a count of lost records, and, if more than 255 have been lost, sends a diagnostic message stating that all records have been lost (this is the likely case). The best thing to do is to reload the records from the optional backup device. The lost record count is cleared whenever the STATS subcommand is run. If the CSC board loses power for an extended time, all data is lost and the error correcting routine sends the corresponding diagnostic message. However, there is a small chance that the error correcting routine will not correct a block of memory, thinking it is already correct. For this reason, it is important to do a "CLEAR" and "SET" whenever an "ALL RECORDS LOST" message is received.

8). SAC error messages, and their explanations, that may be generated during the use of the SAC command are delineated in the System Managers Manual.

i. SERV Command

1). The interconnect shared service command family provides the system manager with those commands necessary to query and/or modify parameters that affect operation of the shared service algorithm. The interconnect parameter limits can be adjusted to meet the demands of traffic based upon time of day as well as the preference of the system owner for grade of service of dispatch versus interconnect call traffic.

2). For the purpose controlling the amount of dispatch versus interconnect call traffic, the day is divided into 12 two hour periods and a differentiation is made between weekdays and weekend days. Then a code is assigned to each of these periods which satisfies the preferences of the system owner. The codes used control six parameters that affect the shared service algorithm. The parameters are:

a). Target average dispatch busy delay - This parameter, measured in seconds, sets a threshold which allows the shared service algorithm to decrease the number of interconnect calls allowed if it is exceeded, and to increase the number of interconnect calls allowed if it is not.

b). Target average interconnect busy delay - This parameter, measured in seconds, sets a threshold which allows the shared service algorithm to increase the interconnect time-out in 30 second increments if it is not exceeded, or to decrease the interconnect time-out in 30 second increments if it is.

c). Repeaters reserved for dispatch calls - This parameter designates (yes/no) whether some or none of the available repeaters will be reserved for dispatch traffic only.

d). Minimum number of repeaters usable for interconnect - This parameter guarantees that a designated number of repeaters will always be available for interconnect call traffic, and if the shared service algorithm tries to reduce the number of repeaters below this figure by controlling the number of simultaneous interconnect calls allowed, then instead it will decrease the interconnect call time-out in 30 second intervals until the minimum interconnect time-out limit is reached.

e). Maximum interconnect time-out - This parameter sets a limit (in minutes) as to how long a single interconnect call will be permitted to continue.

f). Minimum interconnect time-out - This parameter gives the interconnect caller a certain minimum time (measured in minutes) in which to complete his conversation.

The codes combine the above parameters into eight different groupings determined by the specific values assigned. The codes (0 thru 7) are designed to give the system manager a selection that will best satisfy his and his users needs. The codes are:

a). 0 - Factory default designed for optimum balance of interconnect to dispatch call traffic during normal weekday working hours on a normally loaded system.

b). 1 - Factory default designed for optimum balance on weekends and after normal working hours during the week on a normally loaded system.

c). 2 - This code is designed for use on systems that are only lightly loaded i.e. not a great numbers of radios issued such that system is below nominal 100 subscribers per channel.

d). 3 - This code favors dispatch operations by reducing the Target Average Dispatch Delay parameter.

e). 4 - This code favors dispatch operations by reducing the Minimum Interconnect Time-out, such that the shared service algorithm has a shorter minimum time to reduce interconnect calls to.

f). 5 - This code favors dispatch by reducing both minimum and maximum interconnect time-outs.

g). 6 - This code gives a very strong preference for interconnect call traffic.

h). 7 - This code gives a very strong preference to dispatch call traffic because it allows interconnect call traffic to be completely shutout during peak dispatch periods.

3). Another form of control available for use on a system and controlled through the SERV command is dispatch time-out which can be programmed into the central controllers code plug. This time-out provides the system manager with the ability to limit dispatch call length between 0.5 and 3.0 minutes in half minute increments.

If this feature is used then its table of selected values is displayed along with the table of selected values for the shared service algorithm because they use the same format and are both modified through the SERV command.

4). The system monitors the data it requires to compute the parameters for the shared service algorithm continuously and does a computation every 15 minutes. At which time the shared service algorithm can change (increase/decrease) or not change the number of simultaneous interconnect calls allowed and/or change the interconnect time-out. Using the STATS subcommand, the system manager can display some of the data used and some of the parameters computed for the shared service algorithm at the 15 minute intervals. THe data or parameters displayed are:

a). Date/time of report.

b). Average dispatch delay in seconds.

c). Average interconnect delay in seconds.

d). Number of simultaneous interconnect calls (maximum possible).

e). Interconnect call time-out in seconds.

f). Number of active repeaters.

g). Number of dispatch calls.

h). Number of interconnect calls.

i). Average dispatch call length in seconds.

j). Average interconnect call length in seconds.

k). Number of dispatch busies.

l). number of interconnect busies.

STats INST displays the most recent 15 minute interval's statistics, while STats TODAY displays all statistics for the current day broken down into 15 minute intervals up until the time the subcommand was entered. STats YESterday displays the previous 24 hours statistics, but if any earlier data is wanted it can only be gotten from some storage medium that the data was saved to because the central controller will only go back one day.

5). Available subcommands:

a). DISABLE - Disables algorithm from adjusting parameters from set limits.

b). ENABLE - Enables algorithm to adjust parameters from set limits.

c). LIST - Lists shared service parameters.

d). Quit - Exits to GUARDIAN prompt.

e). SET - Edits shared service parameters.

f). SETD - Edits dispatch time-out parameters.

g). STATS - Lists system call processing statistics.

j. STAT Command

1). The STAT command allows the system manager to query the system status. It displays central controller, SAC, shared service, diagnostic, and interconnect settings.

k. TEST Command

1). The TEST command activates the software Diagnostic System Test. It is identical to the manual test performed when activated by the front panel TEST pushbutton on the Central Site Controller module. The software Diagnostic System Test includes tests on all three site controller boards (CSC,RSC,and TSC) and on all equipped optional controller boards (MCB,DCB/ADCB,and SAB).

2). Tests performed:

a). CSC

(1). A test of each RAM integrated circuit.

(2). A test of each EPROM integrated circuit using a checksum process.

(3). A test on battery backed memory.

b). RSC

(1). A test of each RAM integrated circuit.

(2). A checksum test of the EPROM integrated circuit.

(3). An IRB check.

(4). An RIB check - tone detectors.

c). TSC

(1). A test of each RAM integrated circuit.

(2). A checksum test of the EPROM integrated circuits.

(3). A TIB check - Keys channel and checks transmitter status.

d). MCB

(1). A test of each RAM integrated circuit.

(2). A checksum test of the EPROM integrated circuits.

e). PLIB

(1). A test of each RAM integrated circuit.

(2). A checksum test of the EPROM integrated circuits.

(3). A DTMF loopback test.

(4). A dial tone detect test.

(5). A TELCO line test.

(6). A matrix vertical test.

f). DCB/ADCB

(1). A test of each RAM integrated circuit.

(2). A checksum test of the EPROM integrated circuit.

g). SAB

(1). A test of each RAM integrated circuit.

(2). A checksum test of the EPROM integrated circuit.

(3). An SIB check - All audio paths are connected and proper path status return is verified.

3). Test failure indications can be inhibited by putting a particular site controller board in "ALARM CUTOFF". Also a system reset can be initiated from the system manager terminal by entering **(ESC)***.

l. TIME Command

1). The TIME command allows the system manager to query and/or modify the set on the system clock.

2). Format is HH:MM:SS where:

HH = Hour (00 - 23)
MM = Minute (00 - 59)
SS = Second (00 - 59)

m. VER Command

1). The VER command displays current version numbers of various system attributes. These include the code plug, CSC, and MCB.

n. EMRG Command

1). The EMRG command permits the system manager to examine and modify parameters associated with emergency call handling. Certain types of system do not support emergency call processing without the purchase of special options that will permit it. In those systems emergency call requests may be processed by converting them to regular dispatch calls. On some other types of systems the emergency command is not provided in the system manager terminal but the system does support emergency call processing with the parameters for those systems being locked to specific values.

2). Available subcommands:

a). HELP - Lists available EMRG subcommands.

b). Top - Emergency calls assigned to next available channel (Top-Of-Queue).

c). Preempt - Emergency call preempts current lowest priority channel (Ruthless Preemption).

d). Reserve - XX number of channels are reserved for emergency traffic.

e). Hold - Extends message trunked time-out for emergency calls (00:00 to 25:24,Minutes:Seconds).

f). MULY - Emergency calls sent to all members of announcement talkgroup.

g). MULN - Emergency calls sent only to addressed talkgroup.

h). Quit - Exits to the GUARDIAN prompt.

o. MGC Command

1). The MGC command permits the system manager to examine and modify parameters associated with multigroup calls. These parameters control how a multigroup call is processed when affiliated talkgroups are active on the system.

2). Available subcommands:

a). HELP - List available MGC subcommands.

b). Int - Active dispatch calls are interrupted for multigroup calls. All active dispatch calls for talkgroups in the announcement group are terminated and the announcement group call is assigned the first available channel.

c). Wait - Multigroup calls wait until end of dispatch calls for assignment. All active dispatch calls for the talkgroups affiliated with the announcement group are made transmission trunked until announcement group call completed.

d). Stat - List multigroup call processing status.

e). Quit - Exits to GUARDIAN prompt.

p. DVP Command

1). The DVP command permits the system manager to examine and modify parameters associated with digital voice privacy (secure-capable operations).

2). Available subcommands:

a). HELP - Lists available DVP subcommands.

b). Interconnect - Secure-capable units steered to available secure repeaters for interconnect calls. If no secure-capable repeater available the calling unit is notified and permitted to originate the call in the clear mode.

c). Upgrade - Allows normal to secure call upgrade except for emergency calls while the call is in progress.

d). List - Lists status of DVP settings.

e). Quit - Exits to GUARDIAN prompt.

q. DATA Command

1). The main purpose of this command is to inform the central site controller if the Default Data Channels should be assigned during the Reduced mode of data operation. The Reduced mode is entered if the Trunked Data Controller (TDC) and the CSC lose communications. Of the possible channels available to be assigned for a data call, some may be designated as Default Data Channels. Depending on the designation made through this command those channels may or may not be available for dispatch traffic when the system is operating in the Reduced mode. If default data channels are not assignable, they remain under the control of the TDC continuously.

2). Available subcommands

a). Stats - This subcommand displays the current mode (FULL/REDUCED) the data system is operating in and also shows the channels currently assigned as data default channels. Then it displays the selected mode of operation (ASSIGNING/NOT ASSIGNING) for handling the data default channels in the reduced mode of operation. Then the system manager is prompted to change or not change the selected mode of handling the default data channels.

NOTE: If default data channels are ASSIGNED, then if the reduced data mode is entered the TDC will seize those channels and terminate all calls in progress except emergency calls which will become transmission trunked. Thus the default data channels will be used strictly for data calls and not be assigned as voice channels.

If the system manager then designates the default data channels as NOT ASSIGNED, then the CSC will notify the TDC and after 30 seconds the CSC will de-assign those channels from their data calls and make them available as voice channels. The 30 seconds is to allow the TDC to clean up and finish any data calls in progress.

b). Quit - Exits to the GUARDIAN prompt.

r. SITE Command

1). The SITE command permits the systems manager to perform certain operations on specific sites from a remote site SMT or a master site SMT.

NOTE: The SITE command is only applicable to AMSS systems.

a). From the master site, all remote sites may be addressed. This can be done by denoting a specific site (nn), or a range of sites (nn-mm), or all sites in the system (A for all). If no site number is specified, information for the master site only will be displayed.

b). From a remote site, only the information for that site may be accessed and any input that denotes a site number will be ignored.

c). Information available about a site:

(1). Site - From master site either a site number or main/backup indication for the master site. From a remote site main/backup indication. Backup indication only applicable if their is a redundant central controller.

(2). Trunking status (master and remote sites) - Options available are local trunking, wide trunking, trunking, site failsoft, wide failsoft, recovering, and no modem. Options described in System Managers Operating Manual.

(3). Trunking status (master site only) - Options available are idle, causing failsoft, and isolated. Defined in System Managers Operating Manual.

(4). SMT status - Site status entered at SMT (ENABLED/ DISABLED).

(5). DCB status - Site status entered at DCB via ACB pushbutton (ENABLED/ DISABLED).

(6). Remote status - Site status entered at remote CSC via ACB pushbutton (ENABLED/ DISABLED).

(7). Critical status - Critical site information, either CRITICAL or NON-CRITICAL.

(8). Major alarm status - Either set or cleared

(9). Minor alarm status - Either set or cleared.

2). Subcommands available:

a). HELP - Lists valid SITE subcommands.

b). Critical - Sets a site to critical.

c). Disable - Disables a site from the SMT.

d). Enable - Enables a site from the SMT.

e). Initialize - Clears major and minor alarms at a site.

f). Non-critical - Sets a site to non-critical.

g). Status - Displays status of a site or group of sites.

h). Quit - Exits to the GUARDIAN prompt.

6. Telephone Interconnect Commands and Responses

a. AUTH Command

1). The AUTH (authorization) command provides the system manager with those subcommands necessary to build and modify memory tables containing unit IDs and talkgroup IDs authorized for interconnect service.

2). Subcommands available

a). ADD - The ADD subcommand enters a new unit ID or talkgroup ID for TYPE II systems, or, a new Fleet/individual or fleet/ subfleet for TYPE I systems, to the authorization table.

(1). Explanation of fields:

HALF DUPLEX (Y/N) - This feature applies to the individual user's radio. A typical dispatch radio is half duplex.

ENTER LOCAL LIMIT LEVEL (1-4) - The local call limit level specifies the maximum TELCO charge credit for a unit during a billing period. A user who exceeds the assigned call limit level is not allowed to make further calls until the call limit level is increased. The actual dollar amount (0 - $999.99) assigned to the four possible levels can be listed with the LTEL subcommand of the BILL command.

ENTER AUTHORIZATION STATUS LEVEL (1 - 5) - This parameter specifies the authorized TELCO exchange coverage area for that unit through the assignment of one of five possible levels which are:

1 - No calls allowed (monthly fixed AIRTIME charges are assigned).

2 - Calls that are free in the local area code as well as calls to nearby area code(s) that are free.

3 - Free and "unit calls" to exchanges in the local area code or nearby area code(s) that have had exchange rate information entered into the system memory.

4 - All exchanges in the local area code as well as exchanges in any area code(s) specified nearby.

5 - All exchanges in all area codes.

Note: Authorization levels 2 through 5 may require 1+ dialing to be enabled if a 1 is required proceeding the number called, and any type of 0+ calling (credit card) may be allowed if enabled, and also 411, 911, and 800 calls are allowed.

ENABLE 0+ DIALING (Y/N) - Used to enable/disable the ability to make TELCO credit card calls. The rates that will be charged for exchanges in the local or nearby area codes can be displayed using the LEXC subcommand of the BILL command.

ENABLE 1+ DIALING (Y/N) - Must be set to Yes if any exchanges are authorized that require dialing a 1 first as part of the called number.

ENTER CUSTOMER GROUP - The customer group will be used to summarize call information for individual units and talkgroups into customer groups. The customer number may be any value between 1 and FFE. It may be a SAC fleet number if that is convenient, or other numbers can be used to create supergroups or sub groups as required by the system manager. This number need not be added for TYPE I talkgroups, since the customer group is automatically set to the fleet entered.

L-M ACCESS NUMBER IS - This is the six digit number dialed by the land party when calling an individual unit or a group that is authorized interconnect on the system. Whether a TYPE I unit, a TYPE I group (subfleet), a TYPE II unit, or a TYPE II talkgroup is shown be the first digit of the L-M access number. 7 = TYPE II individual, 8 = TYPE II group, 0 = TYPE I individual, and 9 = TYPE I group/subfleet, and because these numbers are direct translations of the hexadecimal designation for the individuals and groups the numbers do not change if the database is lost, therefor they may be re-entered in any order.

NOTE: When the system is first installed, the authorization tables are blank. The default condition is such that for SMARTNET systems mobile-to-land or land-to-mobile calls (if landline caller knows the ID of the radio he wishes to call, no groups) are authorized, and for PRIVACY PLUS systems no interconnect calls are allowed. Also a preset, but modifiable, set of default parameters are selectable as the authorization status by putting an"*" after the ID being added for authorization.

b). TRAN - The TRAN subcommand provides the system manager with those subcommands necessary to build and maintain a table for 4-digit land-to-mobile access numbers. This is provided as a transition from SMARTNET I or PRIVACY PLUS to SMARTNET II/PRIVACY PLUS ENHANCED. The subcommand is used to build a database from which a translation of the 6-digit overdial numbers is provided for the current TYPE I ID back to their 4-digit overdial number(s). This subcommand is only available in systems which have TYPE I radios, and do not use sizecodes: G,H,I,J, and/or K. Only TYPE I radios can be assigned with a 4-digit access number. A TYPE I radio may have several 4-digit access numbers in the range of 1000 - 1699 but still only has a single 6-digit number for an individual radio. Available subcommands:

(1). Add - Add TYPE I unit and assign 4-digit ID.

(2). Delete - Delete TYPE I unit from database.

(3). Reset - Clears all 4-digit translation entries.

(4). List - Provides individual/ complete database list.

(5). Status - Translation table active/not active status.

(6). Quit - Exit to AUTHorization prompt.

c). DELete subcommand - The DELETE subcommand removes an existing unit ID or talkgroup ID from the authorization table.

d). EDIT subcommand - The EDIT subcommand changes authorization parameters that are assigned to a particular unit or talkgroup for TYPE II, or, a fleet/ individual or fleet/subfleet for TYPE I.

e). LIST - The LIST subcommand displays the IDs of users and talkgroup IDs that reside on the authorization table with current settings for each ID. The LIST subcommand may be used to:

(1). List the entire authorization table.

(2). List the data for an individual ID or group ID.
(3). List the data entered for the default authorization record.

(4). List the authorization table for a range of individual or a range of group IDs. List the authorization table for a particular customer group number.

f). STATus subcommand - The STATUS subcommand enables or disables the authorization process. The status should not be made active until all units have been entered into the authorization table to prevent units from being locked out of the system. The status of the authorization list is given to the system manager when exiting the AUTH command.

g). PDIGIT subcommand - The PDIGIT subcommand allows the system manager to specify a digit sequence dialed from a radio that is to be passed on to the TELCO office, but is to be ignored by the CIT. An authorization check or TELCO charge calculation is not performed on the pre-digit sequence.

A pre-digit sequence is required by some TELCO offices to be able to dial a toll call. Five pre-digit sequences of five digits each are allowed for. If not used or to be deleted use "X's", but all entries must be filled in.

h). UPDate - The UPDATE subcommand updates the master authorization table with the changes stored in the temporary Add and Delete tables. This subcommand allows the system manager to place any changes made to the master authorization table in that table and then to continue working in the temporary data files until the current data entry session is complete. Otherwise, no changes will be made until the completion of the session and any LIST or EDIT subcommands will not be able to be executed on the table entries just added or deleted. Exiting the AUTH command automatically updates the master authorization table.

i). RESET - The RESET subcommand causes authorization table, billing, call records and nearby area code exchanges entries to be cleared, setting these functions to the same state as when power was first applied to the system. Authorization and billing databases should be initialized.

j). MSAVE - The MSAVE subcommand causes the MCB to send a copy of memory to a recording device. Records are saved using an error-checking process. During the execution of this subcommand, interconnect call activity is still permitted. The MCB authorization list is automatically updated before saving the records. The SMT generating the MSAVE instruction must have an "intelligent" interface into the MCB for this subcommand to be successfully executed.

k). MLOAD - The MLOAD subcommand causes the MCB to read data from an intelligent storage device, check the data received, and, if valid, place the data into the proper location in memory. Authorization records are set to default during MLOAD, allowing interconnect calls to take place in a SMARTNET system, but not in a PRIVACY PLUS system. Default records can be edited to change the basic operating conditions of the system when in default, such as having the authorization tables in an inactive status. ALL LONG DISTANCE RECORDS ARE CLEARED upon issuing an MLOAD subcommand, therefore make a copy of these records using the SLNG or CLNG subcommands of the BILL subcommand. After an MLOAD authorization records need to be activated and also billing must be activated by doing a RSET under the BILL subcommand. To execute this subcommand the SMT must be installed on an "intelligent" interface.

l). Quit - Exits to the GUARDIAN prompt.

b. BILL Command

1). The BILL command provides the system manager with commands necessary to initially enter and subsequently list and modify parameters used by the CIT to generate airtime and TELCO charges. Summary subcommands are provided for the purpose of listing airtime charges, TELCO charges and long distance/toll call records for each authorized user of the system. The details of the operation of the numerous BILL subcommands is described in the System Manager Operating Manual (68P81079E75-?).

2). Available subcommands:

a). INIT - Initialize airtime and TELCO charge parameters.

b). LAIR - List airtime charge parameters.

c). LTEL - List TELCO charge parameters.

d). LEXC - List exchange rate parameters.

e). MAIR - Modify airtime charge parameters.

f). MTEL - Modify TELCO charge parameters.

g). MEXC - Modify exchange rate parameters.

h). AEXC - Add exchanges and nearby area codes to billing parameters.

i). DEXC - Delete exchanges and all area codes from billing parameters.

j). SAIR - Summarize airtime charge listing.

k). STEL - Summarize TELCO charge listing.

l). CLNG - Summarize logged call listing - computer format.

m). SLNG - Summarize logged calls listing.

n). LOGN - Log long distance calls only.

o). LOGY - Log all calls.

p). PBXN - Remove special call processing.

q). PBXY - Establish special call processing.

r). RSET - Enable or disable airtime and TELCO charge calculations.

s). GRDD - Save/restore memory information to/from tape.

t). Quit - Exits to GUARDIAN prompt.

c. TELL Command

1). The TELL command permits the system manager to enable, disable or check the current status of a particular telephone repeater interface (TRIB) or a particular phone line interface (PLIB). Other TELL subcommands allow the specification of pulse or DTMF dialing for each phone line interface, assign the phone company answer threshold time and allow the specification of the physical connection of a particular telephone repeater interface to a particular central channel number.

2). Available subcommands:

a). Enable - Enable a particular TRIB or PLIB circuit.

b). Disable - Disable a particular TRIB or PLIB circuit.

c). Status - Status of a particular TRIB or PLIB circuit.

d). Phone - Phone line dialing specification (DTMF or pulse) and answer threshold time (0 - 60 seconds).

e). Repeater - TRIB to central controller connection specification.

f). Quit - Exits to GUARDIAN prompt.

3). For phone interfaces the "in sync" or "out of sync" status refers to the data link between the MCB microprocessor and the PLIB's microprocessor.

4). The "answer threshold" which can be modified using the PHONE subcommand is a time setting adjustment that allows the specified amount of time to elapse before an interconnect caller is billed for TELCO charges.

This allows the interconnect caller to terminate the call if the party called is busy or does not answer within the threshold time limit without being billed for the call, therefore preventing overcharging.

5). The default connection between a telephone repeater interface circuit and a central RF channel is TRIB slot 1 connects to RF channels 1, 2, and 3, and then TRIB slot 2 connects to RF channels 4, 5, and 6 etc. If a particular RF channel is not connected to the default TRIB channel assignment, then the MCB must be informed of this change in the RF channel specification using the Repeater subcommand, so that when the central controller assigns a particular RF channel to an interconnect call, the MCB will make the correct connection between TRIB and PLIB for that call.

6). More than a single channels status can be displayed by specifying ALL for channel input portion of the data field. Also, for the PHONE and REPEATER subcommands, the software will display all the possible channels available even though some of them may not be actually in use on a particular system, therefore when all the channels for the system have been addressed, then a Q for quit must be entered to terminate those subcommands.

7. Automatic System Alarm Capability

a. The central controller is designed to alert the system manager when certain central controller or repeater malfunctions occur. This is done in two ways. One is the automatic generation of diagnostic messages on the system manager's terminal (with the system manager's terminal connected to the central controller and in the active mode). The other way is activation of an external alarm device by means of relay contacts triggered by failures reported to the central controller.

No external alarm device is supplied with the central controller, however relay contacts are provided.

b. Diagnostic error messages

1). Format:

DIAG HH DD II SS NN ## CC TT MM......MM

Where: HH = Time
DD = Date
II = Central Identifier
SS = Site Reporting
NN = Device Name
## = Device Number
CC = Condition Reported
TT = Task Number
MM = Message Number(s)

2). Time is displayed in: HH:MM:SS

HH = Hour, MM = Minutes, SS = Seconds

3). Date is displayed: MM/DD/YY

MM = Month, DD = Day, YY = Year

4). Central Identifier specifies reporting Central and its active/idle status.

MA = Main Central, Active
MI = Main Central, Idle
BA = Backup Central, Active
BI = Backup Central, Idle

5). Site Reporting specifies particular site generating diagnostic in a wide area coverage system.

00 = Main Site
01 - 99 = Remote Sites

6). Device Name has seven spaces in which the device referred to in the message is specified by name. xx indicates a channel or port number.

ADCB : AMSS Data Concentrator Board
BIM xx: Base Interface Module
CACB xx: CSC Async Comm Board
CRB : Clock Recovery Board
CSC : Central Site Controller
DACB xx: DCB Async Comm Board
DCB : Simulcast Data Concentrator Board
ICU : Interconnect Control Unit
IRB : Inbound Recovery Board
MCB : Master Control Board
PLIB xx: Phone Line Interface Board
ReSC : Remote Site Controller
RIB xx: Receiver Interface Board
RSC : Receiver Site Controller
RTIB xx: Remote Transmitter Interface Board
SIB xx: Site Interface Board
SAB : Site Audio Board
TACB xx: TCI Async Comm Board
TCI : Trunked Console Interface
TDC : Trunked Data Controller
TIB xx: Transmitter Interface Board
TIMI : Trunked I/O Multiplexed Interface
TRIB xx: Telephone Repeater Interface Board
TSC : Transmitter Site Controller

7). Device Number is the value or range of values that correspond to a particular device name and indicates the specific subsystem or interface referred to in the message. These numbers are in hexadecimal and the lists of diagnostic messages are organized in a hexadecimal order according to these device numbers. Depending on the type of system, there are two sets of device numbers in use.

One uses two digits and the other uses three with the first digit indicating a multiplexed/non-multiplexed device on those systems where applicable. The procedure for finding a specific error message using either set of numbers is the same. Device numbers used in the two digit set are:

00 - 14 : Base Interface Module
15 - 1E : TACB Interface
20 : TIMI (Trunked I/O Multiplexed Interface)
21 : Trunked Console Interface
22 : TIMI - Active (Trunked Interface Module Interface)
23 : TCI-TSC Link
24 : TDC
40 - 54 : Receiver Interface Boards
55 : Receiver Site Controller
56 : Inbound Recovery Board
57 : Clock Recovery Board
58 : Remote Site Controller
59 : Site Audio Board
5A,5B : AMSS Remote Site Controller
60 - 74 : Transmitter Interface Board
75 : Transmitter Site Controller
76 - 8A : Remote Transmitter Interface
90 : Data Concentrator Board
91 - 9A : DACB Interface
9B : TCI-DCB Link
9D : CSC AMSS DCB2 Link
9E : ReSC-DCB Link
9F : AMSS Data Concentrator Board
A0 - B7 : Telephone Repeater Interface
B8 : Master Control Board/ Interconnect Control Unit
B9 - D7 : Phone Line Interface
E0 : Central Site Controller
E1 - EA : CACB Interface
EB : Redundant Link
EF : ReSC-ACB Link
F0 - FE : Site Interface Board

The three digit device numbers may be looked up in the System Manager Operating Manual.

8). Condition Reported denotes a general category of type of action that the system is taking or a general category of type of message that the specific message falls into.

04: Link Failure
05: Link Enable
0A: Enable Device
0B: Disable Device
0C: Malfunction Device
0D: Information Message
0E: Diagnose Device
0F: Error Message

9). Task Number specifies the software task within the specified reporting device. The central controller may perform more than one test on a particular device such as itself. Each test has an assigned task number and the separate "tasks" will generate different diagnostics according to the particular area under test. Some "tasks" do not generate diagnostics as a result of being accomplished, therefore not all task numbers are listed in the detailed listing of error messages.

10). Message Numbers specify the actual failure or action taken. Definitions may vary for each reporting device. Most messages contain a single number but two or more may be issued. If more than one message number issued, the explanation of the additional numbers is provided with the initial message number or after a group of message numbers that all use the same additional explanation.

G. System Manager's Terminal (continued)

11). To interpret diagnostic error messages use the device number and task number to locate the correct block of messages in the detailed listings of messages in the System Manager Operating Manual and then verify that the device name in the listings is the same as the one in the message you are trying to interpret and then look up the message number in that block for the specific condition/action reported.

NOTE: Insure that the section of the System Manager's Operating Manual that you are using to interpret diagnostic messages is the one applicable to your system.

c. Alarm relay contacts

1). Normally closed dry contacts (contacts closed because relay continuously energized during system operation).

2). Major alarm contacts open upon:

a). Loss of AC power to the central controller.
b). Loss of one or more of the DC voltages.

c). Failure of the CSC, RSC, or TSC site controller boards or loss of communications with any of these boards.

d). Failure of the IRB

3). Major alarms means the system will go into FAILSOFT. Can only be cleared by putting the SERVICE ENABLE key switch in the SERVICE ENABLE position or by resetting the site controller board.

4). Minor alarm contacts open upon:

   a). Voice channel transmitter failure.
   b). Tone detector failure on RIB.

   c). MCB failure or loss of MCB communications.

5). Minor alarms are cleared when the source of the alarm is no longer present. Alarms are only functional when the site controller boards are in the RUN mode.

III. Optional Software Features

A. Priority Monitor

1. Priority Monitor is a feature in which a radio operating in one talkgroup can be informed of calls taking place in other talkgroups. If the call taking place on another talkgroup is of a higher priority, as programmed into the radio, then the radio will automatically be switched to that talkgroup.

2. The radios must be Priority Monitor capable, and the Trunked Central Controller (TCC) programming be set for Priority Monitor. For each personalty in the radio there is space allocated for five different talkgroups which the radio can scan. Up to two of these talkgroups can be designated as **Priority** talkgroups. In addition to being programmed into a scan list, Priority talkgroups can be made operator selectable from the radio's keypad.

3. In Priority Monitor, the TCC will output on a voice channel's LSHS the Priority Monitor group's ID. This data is called "priority announcements". A radio (P.M. capable) would pickup this "announcement" on the voice channel and match it to it's record of Priority Monitor groups. If there was a match, the radio would switch over to the control channel, pick up the channel assignment for the Priority group from an update OSW and switch to the new voice channel to join the call in progress for the radio's designated Priority Group.

LABS
AND
TROUBLESHOOTING

CENTRAL CONTROLLER LAB

I. Preliminary Check-out

A. Equipment Set-up

1. Connect the control cables attached to the back of each repeater to the appropriate jacks on the rear of the Controller. This includes the interconnect cables. The channel/frequency set-up chart is usually located inside the card cage.

2. Be sure all cards are in the Central Controller and in the appropriate slots. Make sure they are securely seated. Systems with 5 channels or less require 6 cards in the Controller cage.

3. Select mobiles from the same fleet for the following tests.

NOTE In the following steps, keep in mind that in order to change any push buttons on the Central Controller the appropriate key switch must be in the Service Enable position after making the desired change.

B. Put the Central Controller in the idle state with the following steps:

1. Turn on the main AC power switch.

2. Check that the following lights on the Central Controller are lit:

   a. The **RUN** lights at the top of the CSC, RSC, and the TSC boards.

   b. One of the Control Channel lights on the IRB board.

   c. Disabled lights on the RIB and TIB boards for any channels not in use.

   d. Transmit light **ON** the TIB board for the Control Channel. This will be the same channel number as in "b" above.

   NOTE: All LED'S will light momentarily when power is first turned on.

II. System Test

A. Visual Inspection

1. Visually inspect the Central Controller for any obvious defects. This includes the cabinet fan and its mounting, lightning damage, etc. Also note any failure indicator lights.

2. Inspect spare Central Controller boards, if provided. Be sure they are software compatible with the boards currently installed in the Controller.

B. Measure Power Supply Voltages.

1. Measure the AC input voltage to the Central Controller. The Central Controller requires an input voltage of 97 - 145 volts AC at a current of 12 Amperes, 50 - 60 Hz. It is recommended that AC line conditioner be used.

   AC Input Voltage: ________

2. Using a digital DC voltmeter, measure the +12 volt, -12 volt, and +5 volt power supplies. These voltages can be found along the bus bar located on the rear of the card cage board. Smaller systems will have one 5 volt supply while larger systems will usually have two 5 volt supplies.

3. These DC voltages should be within 100 millivolts of their nominal values.

   +12 Volt Supply: ___________

   -12 Volt Supply: ___________

   +5 Volt Supply: ___________

   +5 Volt Supply: ___________

4. The AC ripple component should be less than 1 percent peak-to-peak of the nominal DC rating. The 5 volt AC supply ripple should be less than 17 millivolts RMS. The 12 volt AC supply ripple should be less than 42 millivolts RMS.

   Ripple on +12 Volt Supply: ________

   Ripple on -12 Volt Supply: ________

   Ripple on +5 Volt Supply: ________

   Ripple on +5 Volt Supply: ________

C.Measure Control Channel Deviation.

1. Connect an antenna or other suitable pick-up device to the input of the Service Monitor.
2. Set the Service Monitor to the transmit frequency of the Control Channel.
3. Put the Service Monitor in the receive mode.
4. Record the deviation on the Service Monitor:

   Control Channel 1 Deviation: _____

   The data deviation should be a minimum of + 2.65 KHz and maximum of + 3.0 KHz.
5. Repeat for the other Control Channels. To change Control Channels push the Disable button on the TIB board next to the current Control Channel. The Control Channel will automatically shift to the next channel.

D. Check Voice Channel Access and Operation.

NOTE: Read step 1 through 3 before doing tests !!

1. Place call on each Voice Channel by keying a mobile transmitter and speaking into the microphone. You should be able to see a repeater key up and hear yourself in other mobile units. Listen for acceptable audio quality. Voice + Low speed deviation (positive or negative peaks) should be a minimum of plus and minus 4.35 KHz and a maximum of 5.0 KHz. Low speed data deviation (positive or negative peaks) minimum of 0.65 KHz and a maximum of 1.3 KHz.

2. Release key on mobile then key again. A different repeater should now key up. Again, check for audio quality. Continue checking each voice channel. You may have to disable some dispatch only base stations to force interconnect base stations into service.

3. Test all Voice Channels using the other Control Channels. To change Control Channels push the Disable button on the TIB board next to the current Control Channel. The Control Channel will automatically shift to the next channel. Check off each Control Channel as it is tested.

E. Check Power Down and Power Up.

1. Turn AC power to the repeaters and Central Controller off, then turn on again.
2. Check that the equipment returns to the idle state and standard diagnostic messages are displayed on the System Manager's Terminal.

F. Check Failsoft Operation.

1. Turn off the power to the Central Controller.

2. After a delay (programmable, typically 1.2 minutes) the yellow failsoft light on each repeater should come on.

3. The mobile's speakers should be un-muted and a 900 Hz tone should be heard every 10 seconds.

4. Place a call with the mobile units and check audio quality.

G. Check operation when no voice channels are available.

1. Disable all channels except the Control Channel by pushing the appropriate Disable buttons on the TIB.

2. Key up each mobile unit and check for the following:

   a. Talk Prohibit Tones - Busy signal type tones in the mobile speaker.

   b. Busy light on each control head comes on.

3. Enable a voice channel and check for mobile Call Back.

    a. Burst of tones in mobile speaker.
    b. Mobile automatically keyed for 3 seconds.

H. Check Continuous Assignment Updating.

1. Select two mobiles with the same Fleet and Subfleet assignments.

2. Turn off one mobile unit.

3. Key up the other mobile unit and hold.

4. With the second mobile unit still keyed, turn on the first mobile unit.

5. The first mobile unit should be immediately assigned to the voice channel which can be determined by being able to talk between units.

I. Check for Talk Permit Tone.

1. Key mobile unit and check for brief series of tones in mobile speaker. These are the same tones that are used for Call Back.

J. Place Fleet and Subfleet calls, if applicable.

1. Communicate between units of one Subfleet and see that units of other Subfleets do not receive. Repeat for all Subfleets. Subfleets are selected by depressing the appropriate button on the control head or by rotating the Subfleet selector knob.

2. Place Fleet Call from one mobile unit and see if it is received by all units in the Fleet.

K. Check Automatic Base Station Identification.

1. Monitor the lowest base station frequency on the Service Monitor.

2. Trigger the BSI mode by setting the clock with the System Manager’s Terminal to just before the half-hour or hour.

3. Leave Service Monitor in the monitor mode and listen for the BSI.

GENERAL SYSTEM PARAMETERS

(All parameters are either positive or negative peaks)

Maximum System deviation.............+ 5.0 KHz

Voice only deviation limits...........+3.70 KHz to +4.0 KHz.

Highspeed data deviation limits.......+2.65 KHz to +3.0 KHz.

Lowspeed data deviation limits........+0.65 KHz to +1.3 KHz.

TRUNKED CONTROL MODULE WORKSHEET

SIGNAL	PIN #	VDC KEYED	VDC UNKEYED	FAILSOFT VDC - KEYED
T STAT	9.	______	______	______
KEYED A+	5.	______	______	______
REFLECTED POWER	2.	______	______	______
REFERENCE	3.	______	______	______
FORWARD POWER	4.	______	______	______
LINE $\overline{\text{PTT}}$	19.	______	______	______
AUDIO $\overline{\text{MUTE}}$	15.	______	______	______
$\overline{\text{MUTE}}$	14.	______	______	______

SIGNAL	PIN #	VDC RX UNSQUELCHED	VDC RX SQUELCHED
R1 SQUELCH	11.	______	______
R STAT	23.	______	______

		VDC CONTROL CHANNEL	VDC VOICE CHANNEL
$\overline{\text{CCI}}$	24.	______	______

SYSTEM MANAGERS TERMINAL LAB

A. Test System Time-Out Parameters.

Following the details in the System Manager's Manual, use the **Parm** command to change one of the system time-out periods.

1. **Carrier Malfunction** - Can be tested by adjusting a repeater's squelch control to indicate a carrier is present. This indication will be on the **RIB**.

2. **Fade Time-Out** - Turn the power off on a transmitting mobile and note the channel hold time.

3. **Message Trunk Time-Out** - Un-key a transmitting mobile and note the channel hold time.

4. **Carrier Time-Out** - Initiate a call with a standard trunked mobile. Turn power off on initiating mobile and at the same time generate on-frequency carrier. Note the channel hold time after the initiating mobile is un-keyed.

B. Perform the following tasks, using the **SMT** manual as a guide.

1. List the emergency parameters. Reserve one channel for emergency calls.

2. Disable and then enable unit 402 00C using the **EDIT** command.

3. Perform a system reset.

C. Interconnect Test.

1. Following details in the System Manager's Manual, place a mobile on the **AUTHORIZATION** list.

2. Make an interconnect call in the land to mobile direction.

3. Make an interconnect call in the mobile to land direction.

4. Check audio quality.

1. PROBLEM: TALK PROHIBIT TONE (busy light not activated)

POSSIBLE PROBLEM:

A. Mobile out of range.

B. Is Control Channel on the air?

C. Does mobile send ISW?

  1. Mobile sends more than one ISW.

    A. Does unsquelch and decode LED's on IRB flash?Yes - IRB is okay.

    B. Unsquelch LED does not flash with ISW suspect fault in IRB or base repeater interface.

    C. Receive LED on RIB should flash with ISW. If not suspect fault in base repeater interface.

    D. Unsquelch LED flashes, decode LED does not flash. Check for proper receive data at the IRB. Data okay -suspect fault on IRB.

  2. Mobile sends only one ISW.

  NOTE: Mobile has failed its handshake on the assigned voice channel.

    A. Does transmit LED on TIB turn on?

    B. LED turns on - TIB, TSC okay.

    C. LED does not turn on - try another voice channel and LED turns on - suspect fault in that voice channel interface or TCM of base repeater.

    D. LED still does not turn on - suspect fault on TIB or TSC.

2. PROBLEM: MOBILE HEARS SHORT BURST OF TONE BEFORE TALK PERMIT IS RECEIVED.

POSSIBLE PROBLEM:

A. Mobile is in marginal RF area.

B. Marginal base station. Controller decides to select voice channel X, but channel X is marginal - it will shut down X and then select channel Y. Because of the time lag mobile will start to send an out of range tone followed by a talk permit tone. You can verify this at the controller and watch it go through test sequence. Manually disable channel X and see if problem in mobile disappears.

3. PROBLEM: NO CONTROL CHANNEL.

POSSIBLE PROBLEM:

A. Check IRB to determine if a control channel has been assigned (one IRB LED should be on).

B. If IRB LED is turned on, check the corresponding TIB for a TX LED on condition.

C. If repeater is not keyed, check to determine if the TCM is receiving transmit data from TIB, also check if the TCM is passing the data on to the exciter. If data is there, fault is in repeater.

D. If the TX LED on TIB is not on, replace the TIB, TSC, one at a time.

E. If the control channel cannot be manually moved to another channel, there is a fault in the TIB-TSC boards.

F. If none of the control channel LED's are turned on and the TIB-RIB pair are not enabled, replace both TSC and RSC boards.

G. If the RIB-TIB are enabled, but none of the channel indicators on the IRB are on, suspect a fault in the IRB or RSC.

4. PROBLEM: ERRATIC ASSIGNMENT OF CONTROL CHANNEL

POSSIBLE PROBLEM:

A. Intermittent Trunk Control Module (TCM) - power detect circuit or TSTAT signal to controller.

B. Transmitter power output low at base station.

C. Software problem, control channel will not change on 24 Hr. rollover period. Contact product group.

5. PROBLEM: ONE BASE REPEATER IN FAILSOFT CONDITION.

POSSIBLE PROBLEM:

A. Look for transitions on the MUTE line at the TCM.

B. If no transitions are seen, suspect a failure in the TIB-TSC boards.

C. If transitions are seen on this line, suspect a failure in the TCM.

6. PROBLEM: ENTIRE SYSTEM IN FAILSOFT CONDITION.

POSSIBLE PROBLEM:

A. Interruption of AC supply to controller.

B. Power supply failure.

C. Site controller failure - initiate the on-board diagnostics on each site controller board, look for failure light.

D. If terminal is hooked up to controller it will read out possible failure mode.

7. PROBLEM: INTERMITTENT OPERATION SYSTEM RESTARTS, ERRATIC OPERATION.

POSSIBLE PROBLEM:

A. Always check 5 volt and 12 volt power supplies for power supplies for power voltages (+5.15 V +- .1 V, + 12 V +- .1 V) - refer to Controller Manual.

B. Noisy 5 volt power supply - check filter capacitors C4 and C5 - capacitors not making good connection to circuit. Check AG noise with scope.

C. Refer to SRN 935 for possible problem area.

   1. High ambient temperature.

   2. Edge contacts on central boards dirty.

   3. Poor cabinet grounding.

I. Systems Preliminary Checks

A. The following information may be utilized with the aid of one (1) trunked mobile, an oscilloscope and monitor.

B. CSC should be in a functional state such that it can initialize itself properly and remain in the idle state, awaiting for call related work.

1. This may be verified by ascertaining which repeater is up as the control channel. This will be normally be repeaters 1 through 4. Verify by visually checking the IRB, which will have one of the 4 LED's lit indicating the control channel. Check the frequency of the crystal on the repeater and set the IF monitor or other type of monitor to this frequency. You should hear a steady low tone of 3600 Baud data being transmitted and interrupted very briefly and changing speed as a mobile tries to access the system.

2. If this condition does not exist, check the front panel LED's to see if they are continually flashing (system in reset mode) or if any of the SCB modules FAILED LED's are active. This is an indication of a major system fault which must first be corrected before calls are processed.

C. At this point, look at the troubleshooting from a mobile in the field standpoint.

1. Perform an INDICATOR TEST. Push the indicator test button to verify all indicators are functioning properly.

2. The ALARM CUTOFF switches may be depressed to prevent the inadvertent activation of alarms while troubleshooting.

3. Key a mobile, listen for either a Talk Prohibit Tone (a steady tone) or a busy tone (a pulsating tone). If neither detected, all is OK at this point with the exchange of data.

4. Find the TIB card. Use the mobile radio to access the system. While watching the TIB XMIT LED indicator depress the PTT switch.

    a. If the LED does not come on suspect the TIB or TSC board to be bad.

    NOTE: Follow all ESD precautions!!

System preliminaries cont'd.

D. If depressing and releasing the PTT switch on the mobile, the mobile gives a TALK PROHIBIT TONE.

1. REMEMBER -- If the mobile sends only one ISW, it indicates that:
    - (a). The Control Channel is functional.
    - (b). The ISW was received and decoded properly.
    - (c). An OSW grant was generated and sent to the mobile via the Control Channel.
    - (d). The mobile unit probably failed its handshake on the assigned voice channel.

2. The TALK PROHIBIT TONE indicates the mobile is unable to communicate with the Central Controller.

    a. Suspect the TSC, TIB, CSC boards.
    Replace one at a time and if no correction, suspect the repeater base control.

    b. Check the TCM in the repeater for proper processing of the transmit data.

F. Improper Data received by the mobile.

1. Check the TDATA lines from the Central Controller to the base repeater.

2. Check for active states on the PTT and MUTE lines. If improper suspect TIB or TSC.

3. IF TDATA, PTT, AND MUTE lines appear correct to the base repeater, the repeater should be checked.

    a. Check the signal process of the TCM. If OK, it is probably an RF problem.

System preliminaries cont'd.

G. TALK PERMIT but no tone.

1. The base repeater should be sending a low-speed Connect Word along with the voice information.

   a. The RCV indicator on the RIB associated with the voice channel should be lit since the mobile is in the transmit mode. If it is not lit the repeater -- RIB interface or repeater receiver is at fault.

   b. If RCV indicator is lit, check RDATA lines to see if data is being transferred from repeater discriminator to the RIB.

   c. If data transfer is not proper, check the TCM signal processing of the received data as well as the receiver section of the base repeater.

   d. If data is OK, check the RIB, RSC, and CSC.

   e. If fault does not clear check the TIB & TSC modules.

H. If voice information is not repeated check the MUTE line to the base repeater. If this line is active check the TIB or TSC.

1. After approximately 1.2 seconds, the base repeater terminates its low-speed Connect Word transmission in the un-muted state. This indicates that the RIB could not detect the low-speed Connect Tone. Replace the RIB. If not cleared, check the RSC.

I. When the mobile un-keys, the mobile transmits a DISCONNECT TONE to the base repeater. This tone is used to initiate the muted disconnect sequence. If the MUTE line is not activated, then the Disconnect Tone was not detected.

1. Replace the RIB or the RSC.

2. If not corrected, replace the TIB or TSC.

3. If the repeater does not switch to the disconnect sequence, look for faults in the TIB, TSC, and CSC.

System preliminaries cont'd.

J. More than one ISW.

1. This indicates that the initial ISW is not being properly processed by the central processor.

    a. Key the mobile -- observe the UNSQUELCH and DECODE LED's on the IRB.

    b. The UNSQUELCH LED should flash each time the mobile transmits an ISW. If not, change the IRB or check repeater interface. The RIB associated with the Control Channel should also flash at each ISW. If not, the base repeater interface should be suspected.

    c. Key up mobile -- observe the DECODE LED. The LED should flash with each ISW.

    d. If the DECODE LED does not flash check the data received at the IRB from the repeater -- Central Controller interface. Improper data indicates an interface problem.

    e. If data is OK then replace the IRB.

K. Major Alarms.

1. The MAJOR ALARM is activated when a fault totally disables the system or impairs its major function.

    a. Power supply failure.

        (1). +5 V, -5 V, +12 V, -12 V

    b. Site Controller failure: CSC, RSC, or TSC.

    c. Control channels failure:

        (1). RF base repeater failure.
        (2). Repeater SCB interface failure.
        (3). IRB failure.

    d. The MAJOR ALARM external indication can be blocked by means of the ALARM CUTOFF front panel switch on the CSC, unless either +5 V power supply has failed. This allows checking of the alarm causes without distraction of the audible alarm.

System preliminaries cont'd.

2. If a power supply is improper, adjust or replace defective units. Re-check the power supplies.

3. Check of possible site failure. If FAILURE indicator is lit on SCB, there may be a problem with the SCB or associated peripheral modules.

    a. If the SCB with the failure indication is the RSC, the IRB, RIB, and RSC modules should be checked as follows:

        (1). If the FAILURE indicator on the IRB is lit, check either the IRB or the RSC

        (2). If all RIB channels indicate DISABLED mode even though the front panel switches indicate an IN SERVICE status, check the RIB and RSC.

        (3). If only the FAILURE LED is lit, the RSC may be at fault.

4. If the SCB with the failure lite is the TSC, then the TIB and TSC modules should be checked.

    a. If all TIB channels indicate DISABLED mode, even through the front panel switches indicate IN SERVICE status, the TIB and TSC may be at fault.

5. If only the FAILURE LED on the TSC is lit, check the TSC.

6. If the SCB with the failure is on the CSC, replace and check system.

L. MINOR ALARMS

1. The MINOR ALARM indicates the occurrence of a fault that does not cause total failure of the system.
    a. This happens when an enabled channel malfunctions and is detected by the RSC (illegal carrier detect signal), or the TSC (transmitter power failure signal).
    b. The alarming channel will be indicated on the front panel of the affected RIB or TIB.
    c. The DISABLED LED lites for a channel which has its CHANNEL push-button set in the ENABLE position.
    d. The alarm condition may be removed by disabling this channel by means of the associated front panel push-button on the RIB or TIB.
2. If the MINOR ALARM is activated without an apparent channel failure look for a faulty SCB.
    a. Initiate the on-board diagnostics for each SCB module. If they are normal, check the alarm relay backplane circuitry for possible fault.
    b. MINOR ALARM audible/visual lites can be disabled by operating the ALARM CUTOFF switch on the CSC.

III. TRUNK CONTROL MODULE

It has been noted that a failure on this module is often misinterpreted as a failure in the Central Controller. In order to facilitate out-of-station testing of these modules, the attached check-out procedure was developed.

The basic functions performed by the module are as follows:

1. Monitor pulses from the Central Controller, via the MUTE line (pin 14), and will put the station in failsoft if these pulses are not detected.

2. Generates the failsoft code and routes it to the exciter in the failsoft mode.

3. Passes data from the Central Controller, via the TDATA (+) and TDATA (-) inputs (pin 17 and 18), to the exciter input in the trunked mode of operation.

4. Monitors the levels of Forward and Reflected power and provides a logic indication, via the TSTAT line (pin 9), which notifies the Central Controller if the Forward power drops below a reference point or if the Reflected power exceeds a certain reference.

5. Provides an indication of received carrier via the RSTAT line (pin 23).

6. Accepts discriminator audio via the RECEIVER SITE DATA input (pin 13) and passes it on to the Central Controller via the DISC output (pin 20).

TEST PROCEDURE FOR TRUNK CONTROL MODULE (TCM)

PROGRAMMABLE TIMER AND ASSOCIATED CIRCUITRY

Set up the module using the attached procedure. Apply power to the module and verify that the green LED (trunked mode) illuminates. Pin 13 of U6 should be at a logic low. Also verify, that a 14 Hz (70 mSec period) waveform is present at U6 pin 3. Edge connector pin 19 should be at a logic high.

Allow the module to go into the failsoft mode (1.2 minutes typical) and verify that pin 19 (LINE PTT) goes low. The green LED should be off and the yellow LED (FAILSOFT) should be on. Pin 13 of U6 should be at a logic high.

Apply a momentary ground to pin 14 (MUTE). This should put the module back in the trunked mode and pin 15 (AUDIO MUTE) should go low as long as the ground is applied to pin 14.

FAILSOFT CODE GENERATOR and ASSOCIATED CIRCUITRY

A continuous 900 Hz square wave should be present at U13B pin 3. It should appear as a 250 mSec burst, occurring every 10 seconds, at U13B pin 9. This alert tone burst is then passed through U5B and on to U5D where it is combined with the failsoft code. The failsoft code superimposed with alert tone is present at pin 4 of U2 at all times. During failsoft, the code and alert tone is gated on to U2 pin 3 and on through the remaining sections of U2 and finally appears at edge connector pin 7 (Exciter Data).
With 1 KHz (600 Ohms balanced at 1 Volt RMS) applied to pins 17 and 18, put the module in the trunked mode by momentarily grounding pin 14 (MUTE). The 1 KHz signal should then appear at edge connector pin 7 (Exciter Data).

FORWARD and REFLECTED POWER DETECTORS (TSTAT)

In order to test this portion of the module using the TEK 38 module tester, insure that the attached set up procedure is followed. In this mode, with the 2 external jumpers in (JUA and JUB), the TSTAT line (pin 9) will be at a logic low.

Remove the ground jumper (JUB) on pin 2 and the TSTAT line should switch high. With JUA and JUB removed, the TSTAT line should switch low again.

NOTE: Adjustment of the forward power trip point (R103), during this procedure in NOT advised.

RSTAT CIRCUITRY

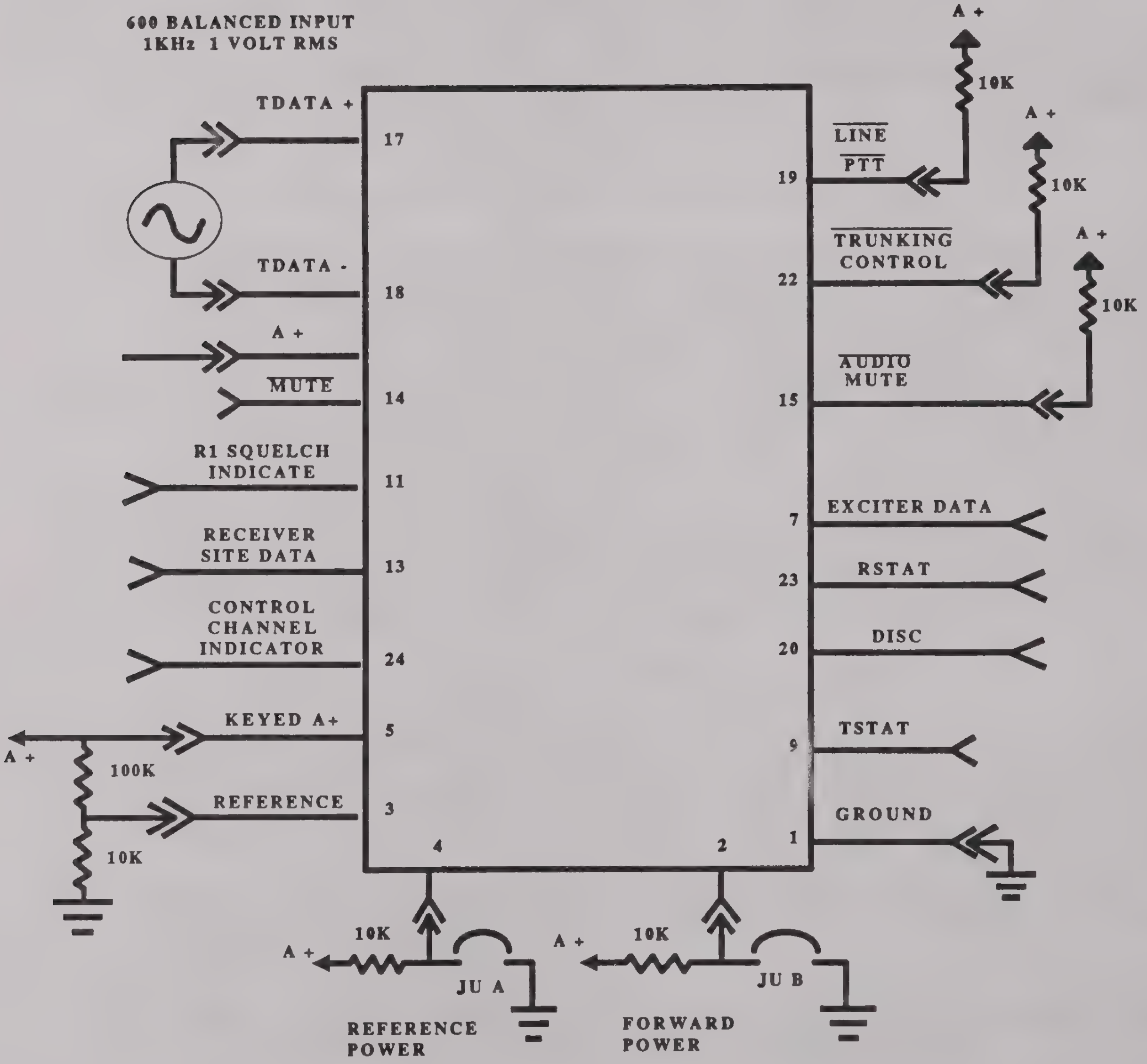
To check this portion of the module, simply apply ground to pin 11 (R1 Squelch Indicate) and verify that pin 23 (RSTAT) goes low in conjunction with the ground applied to pin

11.RECEIVER SITE DATA INPUT and DISCRIMINATOR OUTPUT

Connect an unbalanced 1 KHz signal (1 Volt RMS) to pin 13 (RCVR SITE DATA) and place a ground on pin 24 (CONTROL CHANNEL INDICATOR). This causes the 1 KHz signal to pass through U7C and U5C. Note the amplitude of the signal at pin 20 (DISC).

Now remove the ground from pin 24. This causes the 1 KHz signal to pass through U1A, U7D, and U5C. The output should be approximately double the previous reading.

TEST SETUP FOR THE TRUNKED CONTROL MODULE USING THE TEK-38 BASE STATION MODULE TESTER


600 BALANCED INPUT
1KHz 1 VOLT RMS
TDATA +
17
TDATA -
18
A +
MUTE
14
R1 SQUELCH INDICATE
11
RECEIVER SITE DATA
13
CONTROL CHANNEL INDICATOR
24
KEYED A+
5
A +
100K
REFERENCE
3
10K
4
2
10K
A +
JU A
REFERENCE POWER
A +
10K
JU B
FORWARD POWER
A +
10K
LINE PTT
19
A +
10K
TRUNKING CONTROL
22
A +
10K
AUDIO MUTE
15
EXCITER DATA
7
RSTAT
23
DISC
20
TSTAT
9
GROUND
1

TCC QUIZ

1. Trunking is the automatic sharing of a group of communications paths among a large number of users.

   A. True_____

   B. False____

2. What is the single most important asset of trunking over conventional systems ?
   - A. The ability to allow each unit to be in more than one conversation group.
   - B. Privacy
   - C. The ability to dramatically decrease waiting times.
   - D. None of the above

3. The Base Station Identification(BSI) is generated by which piece of equipment in a trunked system?
   - A. Centracom
   - B. Repeater
   - C. Central Controller
   - D. System Watch

4. What option will allow the system manager to transmit a message to every unit on the system, interrupting any calls in progress?
   - A. Call Alert
   - B. Fleet/Announcent Group Call
   - C. Private Call
   - D. System Call

5. What capability allows two radios to establish totally private conversations?
   - A. Priority Monitor
   - B. Call Alert
   - C. Private Conversation
   - D. Subfleet Call

6. Which feature(s) is/are optional on a trunked radio system?
   - A. Private Conversation
   - B. Call Alert
   - C. Telephone Interconnect
   - D. All of the above

7. A SIMS/SCMS operator can change the fleet/announcement group or subfleet/talkgroup assignments of any mobile, portable, or group of radios without any action being required on the part of the radio operators. What feature allows the operator this capability?

A. Supervisory Regroup
B. Dynamic Regrouping
C. Talkgroup Merge
D. None of the above

8. Which type of trunking allows an variable time-out period after a radio dekeys before a repeater may be reassigned to other users?

A. Message Trunking
B. Channel Trunking
C. Transmission Trunking
D. Conventional Trunking

9. A repeater drops out as soon a user unkeys. What type of trunking is this known as?

A. Message Trunking
B. Channel Trunking
C. Transmission Trunking
D. Conventional Trunking

10. How many priority levels are there on a Smartnet II system?

A. Unlimited
B. Twelve
C. Five
D. Eight

11. How many priority levels are there on a Smartnet I system?

A. Unlimited
B. Twelve
C. Five
D. Eight

12. Which of the following is the highest priority level?

A. Operational
B. Tactical
C. Emergency
D. All the above have the same priority

13. A priority One level can be assigned by which one of the following?

A. Dispatcher
B. No one
C. System Manager

14. When the System Central Controller is rendered inoperative, the radios will automatically revert to pre-assigned channels and become capable of communications with one another. This feature is know as?
   - A. Fast Fail
   - B. Fail Soft
   - C. Last Means Comms
   - D. Untrunked Comms

15. The feature that allows a unit involved in a conversation to be switched back to his home group is known as?
   - A. Instant Recall
   - B. Call Alert
   - C. Priority Monitor
   - D. Passport

16. The maximum number of channels a Smartnet Central Controller can be equipped to handle is?
   - A. 21
   - B. 14
   - C. 28
   - D. 7

17. The minimum number of channels required for trunking operation is?
   - A. 5
   - B. 1
   - C. 2
   - D. 3

18. On a eight channel system, how many channels can be available as Interconnect channels?
   - A. 3
   - B. 5
   - C. 2
   - D. 7

19. The ID I700001 identifies which of the following in a Type II system.
   - A. Fleet
   - B. Announcement Group
   - C. Radio
   - D. Talk Group

20. In a Type II system the Central automatically knows Talk Group to Announcement Group affiliations.
    - A. True
    - B. False

21. In a Type II system, individual to Talk Group affiliations must be entered thru the use of a SMT.
    - A. True
    - B. False

22. The SMT can do all of the following except for?
    - A. Change System Parameters
    - B. Dynamic Regrouping
    - C. Disable a channel
    - D. Delete a user

23. Which of the following would cause a system to go into failsoft?
    - A. BSI channel failure
    - B. TRIB channel three failure
    - C. Repeater #1 with high SWR
    - D. RSC failure

24. The TCM/TTRC has how many modes of operation?
    - A. Three
    - B. One
    - C. Four
    - D. Two

25. The TCM/TTRC generates the failsoft data word t[redacted]e?
    - A. Every ten seconds
    - B. Randomly
    - C. All the time
    - D. Every .3 seconds

26. If you forget the password for SMT, it can be?
    - A. Retrieved by using PARMS
    - B. Echoed on the screen using EDIT
    - C. Retrieved using HELP
    - D. None of the above

27. An authorization level of 1 will allow a radio user to?
    - A. Not make any Interconnect calls
    - B. Make unlimited calls
    - C. Make only 1+ calls
    - D. Have top priority when making Interconnect calls

28. A user with an authorization level of one attempts to make interconnect call. Will he be billed for airtime charges?
    A. No, because the interconnect called was not allowed.
    B. No, because there is no airtime billing for interconnect calls
    C. Yes, because he will be charged for interconnect usage.
    D. Yes, because airtime was involved in the attempt

29. In type II systems the HSHS is used for the following;
    A. Sending the affiliation request to the radio that failed to send a Talk Group ID
    B. Informing the radio of it's channel grant
    C. Sending Priority Monitor information on assigned voice channels
    D. Not used due to the signalling format

30. While a radio is receiving the interconnect ringing, can it receive dispatch calls?
    A. No,because it is already in the phone mode
    B. Only in emergency mode
    C. Yes, if it is a dual mode radio
    D. Yes, because it has not been placed in the interconnect mode at that time

31. The ISW is:
    A. Decoded by the TCM and verified by the RSC
    B. Decoded by the TCM and verified by the TSC
    C. Processed by the IRB and verified by the TSC
    D. Processed by the IRB and decoded by the RSC

32. Which of the following interrupts a)FIRQ,b)IRQ,c)NMI has the highest priority?
    A. FIRQ
    B. NMI
    C. IRQ
    D. All have the same priority

33. A MCB board failure places the system into FAILSOFT due to loss of interconnect capabilities.
    A. True
    B. False

34. A TCI board failure can place a system in FAILSOFT.
    A. True
    B. False

35. The Disconnect word is sent out on the:
- A. Voice channel
- B. Control channel
- C. Interconnect channel
- D. Control & Voice channel

36. Baud rates on the CSC are:
- A. SMT operator selectable
- B. Can only be set by the factory
- C. Selectable by jumpers
- D. Loaded in by SIMS

37. The CSC does the time-out for:
- A. Carrier Malfunction
- B. Message Trunking
- C. Fade time
- D. Carrier time

38. Which board does the remaining time-outs?
- A. TSC
- B. RSC
- C. RIB
- D. TIB

39. An advantage of LOOP START is the ability to place additional calls without "hanging up".
- A. True
- B. False

40. Site controller boards back-up batteries last approximatly?
- A. 150 minutes
- B. 180 minutes
- C. 45 minutes
- D. 82 minutes

41. An error message "MA 00 RSC 55 OF 00 02" indicates?
- A. Bad OSW op code
- B. Power fail restart
- C. Echo sync loss
- D. Unknown command

42. An error message "MA 00 IRB 56 OF 00 21" indicates?
- A. IRB interrupy failure
- B. IRB double buffer failure
- C. IRB device status
- D. IRB restart

43. The TCM/TTRC generates the Failsoft alert tone every 10 seconds?

A. Continuously
B. Only during trunking
C. Only during failsoft
D. Upon command from the SMT

44. Removing the TCI board from a system will?

A. Cause the loss of the Dispatchers console
B. Be of no consequence
C. Cause the dispatcher to use a portable radio
D. Sent the trunked system into the failsoft mode

45. Mobile/Portable users can not access the system, yet they are locked on to the system. A possible fault could be?

A. ACB board
B. RSC board
C. IRB board
D. RIB board

1. List the eight (8) control signals (excluding shield grounds) which make the interface between the Central Controller and the repeater.

a. ______ b. ______

c. ______ d. ______

e. ______ f. ______

g. ______ h. ______

2. Give a brief description of the function of each control signal.

a. ____

____

b. ____

____

c. ____

____

d. ____

____

e. ____

____

f. ____

____

g. ____

____

h. ____

____

3. The following events make up the trunking call process. Arrange the events in the appropriate order in which the call process occurs. The call process has been divided into logical sections. Each section contains the detailed function of the call process associated with it. The events for each section are only contained on that page.

Section I: **IDLE SYSTEM, NO CALL ACTIVITY**

a. Mobile synchronizes to control channel data.

b. Control channel is transmitting only background OSW's.

c. Mobile remains synchronized after decode of System ID.

d. Mobile scans preassigned control channel frequencies.

e. Mobile radio is turned on for first time.

1. System is on the air with a control channel.
2. ______
3. ______
4. ______
5. ______
6. ______
7. Mobile operator depresses PTT on mic.

Section II: **MOBILE RADIO SENDS IN A REQUEST FOR A CHANNEL**

a. IRB loads ISW into shift registers on board.

b. CCI line causes ISW to be filtered by Discriminator Amplifier board at control channel receiver.

c. Mobile transmits ISW request on control channel.

d. ISW is sent down DISC line to IRB.

e. RSC takes ISW from IRB shift registers.

f. IRB samples ISW five (5) times per bit time.

g. RSC passes decoded ISW to CSC.

h. ISW is received at control channel receiver.

i. RSC decodes and validates format of ISW.

1. PTT is depressed at mobile mic.
2. ______
3. ______
4. ______
5. ______
6. ______
7. ______
8. ______
9. ______
10. ______

Section III: **CSC DECIDES WHAT TO DO WITH REQUEST**

a. CSC determines if a channel resource is available.

b. CSC sends OSW to RSC.

c. CSC checks subscriber records to see if a channel should be assigned for the call request mode.

d. CSC sends OSW to TSC.

e. CSC formulates channel assignment OSW.

1. CSC places ISW in a queue.
2. ______
3. ______
4. ______
5. ______
6. ______

Section IV: **CHANNEL ASSIGNMENT IS MADE AND SENT TO MOBILES**

a. Control channel transmits background word alternating with OSW.

b. TSC sends Highspeed data to TIB.

c. Voice channel transmits highspeed data.

d. TIB sends OSW down TDATA lines to control channel transmitter.

e. Mobiles in system decode OSW.

f. TSC passes OSW to TIB every other word time.

g. TSC tells TIB to key assigned voice channel.

h. TIB sends highspeed data down TDATA lines to voice channel transmitter.

NOTE: In this section two (2) processes are occurring parallel with each other. The two (2) columns are for each process.

1. TSC receives OSW from CSC.

2. ______	6.______
3. ______	7.______
4. ______	8.______
5. ______	9.______

Section V: **HANDSHAKE ON VOICE CHANNEL**

a. RSC reads RIB and sees ACK tone detected.

b. ACK tone filtered at Discriminator Amplifier Board of voice channel receiver.

c. Mobiles synchronize to highspeed data.

d. RSC passes "ACK tone detected" to CSC.

e. ACK tone received on voice channel receiver.

f. RIB detects ACK tone.

g. Mobiles decode highspeed data.

h. Initiating mobile matches individual ID in highspeed data.

i. ACK tone passed down DISC line to RIB.

j. Initiating mobile transmits ACK tone on voice channel.

1. Mobiles who match fleet and subfleet in OSW synthesize to voice channel assigned.

2. ______

3. ______

4. ______

5. ______

6. ______

7. ______

8. ______

9. ______

10. ______

11. ______

Section VI: VOICE CHANNEL BECOMES LOWSPEED DATA UN-MUTED.

a. TIB sends lowspeed data down TDATA lines to voice channel transmitter.

b. TIB lets MUTE line go high on voice channel repeater.

c. CSC sends lowspeed data word to TSC.

d. TSC tells TIB to unmute voice channel.

e. CSC formulates lowspeed data word.

f. TSC sends lowspeed data word to TIB.

1. CSC receives "ACK tone detect" from RSC.
2. ______
3. ______
4. ______
5. ______
6. ______
7. ______

Section VII: **MOBILE AUDIO IS REPEATED AND HEARD.**

a. TSC sends lowspeed data to TIB.

b. Connect tone is sent down DISC line to RIB.

c. RSC passes "Connect Tone Detect" to CSC.

d. Initiating mobile transmits audio and Connect Tone.

e. Lowspeed data is transmitted with mobile audio.

f. RIB detects Connect Tone.

g. Mobiles on voice channel decode lowspeed data.

h. RSC reads RIB detected Connect Tone.

i. Mobiles on voice channel unmute their speakers.

j. CSC continues to let TSC send lowspeed data.

k. Audio is repeated on voice channel and Connect Tone is filtered at Discriminator Amplifier Board in receiver.

l. TIB sends lowspeed data down TDATA lines to voice channel transmitter.

1. Mobiles on voice channel receive lowspeed data.

2. ______
3. ______
4. ______
5. ______
6. ______
7. ______
8. ______
9. ______
10. ______
11. ______
12. ______
13. ______

Section VIII: MOBILE ENDS CALL BY UN-KEYING MIC.

a. Disconnect Tone filtered at Discriminator Amplifier Board of voice channel receiver.

b. RSC passes "Disconnect Tone Detect" to CSC.

c. Disconnect Tone sent down DISC line to RIB.

d. Initiating mobile transmits Disconnect Tone.

e. RIB detects Disconnect Tone.

f. Disconnect Tone received at voice channel receiver.

g. RSC reads Disconnect Tone detect from RIB.

1. Mobile un-keys PTT on mic.
2. ______
3. ______
4. ______
5. ______
6. ______
7. ______
8. ______

Section IX: **CENTRAL ENDS THE CALL ASSIGNMENT.**

a. CSC waits for repeater hang-time.

b. CSC removes call from queue.

c. CSC tells TSC to send Disconnect data.

d. TSC sends Disconnect data to TIB.

e. TIB sends Disconnect data down TDATA lines to voice channel transmitter.

1. CSC receives "Disconnect Tone detect" from RSC.
2. _______
3. _______
4. _______
5. _______
6. _______

Section X: **MOBILES ALL MUTE SPEAKERS, CALL IS ENDED.**

a. TSC tells TIB to un-key and mute assigned channel.

b. Mobile mute speakers.

c. Mobiles synchronize to control channel data.

d. TIB un-keys voice channel transmitter and lets MUTE line go low.

e. Mobiles decode Disconnect data.

f. Mobiles synthesize to control channel frequency last seen.

1. Mobiles on voice channel receive Disconnect data.
2. ______
3. ______
4. ______
5. ______
6. ______
7. ______

4. When the CSC shows the **FAILURE LED** on and the **ACTIVE LED** is blinking at a 10 Hz rate, list one probable cause for this failure mode.

5. CSC shows **RUN LED** and RSC and TSC show **RUN LEDs** and **DISABLE LEDs**, list a probable cause for this failure.

6. TSC shows no **LEDs** and the TIB shows all **DISABLE LEDs**, list a probable cause for this failure.

7. IRB shows constant **UNSQUELCH LED** on and control channel is currently channel 1, list a probable cause for this failure.

8. TIB shows constant **XMIT** and **DISABLE LEDs** for channel 2 only after a Central reset, list one probable cause for this failure.

9. RIB channel 3 shows constant **RCV LED**. What does this indicate?

10. After cycling the disable switch for channel 4 RIB and the **DISABLE LED** remains on what does this mean?

____

____

11. After a RIB channel failure the Central Controller will never use that RIB channel again.

TRUE FALSE

12. If the Central Controller were to fail all of its possible control channels it would:

a. Allow the repeaters to enter failsoft.

b. Switch to lowspeed data word.

c. Send out BSI on the lowest frequency.

d. Call Jay on dialup modem.

13. If the repeater control cables for channels 4 and 5 were reversed the mobiles on the system would:

a. Not notice any difference.

b. Fail highspeed data handshake when assigned either of these two (2) channels.

c. Lose lock on the control channel and scan for another control channel.

d. Call Jay via the centralized interconnect unit.

MOTOROLA INC.
Communications
Sector

instruction manual revision

GENERAL:

This revision outlines changes that have occurred since the printing of your instruction manual. Use this information to correct your manual.

INSTRUCTION MANUAL AFFECTED:

68P81066E60–C	Trunked Radio System Controller – Privacy Plus™ and SMARTNET™
68P81082E15–O	Trunked Radio System Controller – SmartWorks™

REVISION DETAILS:

Insert attached section 68P81084E51 into your manual following section 68P81040E12 behind the MODULES tab. The attached section provides documentation for the TRN8663B Transmitter Interface Board (TIB). The TRN8663B performs all the functions of the earlier TRN8663A and provides additional capabilities. Indicate this addition in the Table of Contents.

ATTACHMENTS:

TRN8663B Transmitter Interface Board (TIB) 68P81084E51–O

MOTOROLA INC.
Communications
Sector

TRANSMITTER INTERFACE BOARD

MODEL TRN8663B

1. INTRODUCTION

The TRN8663B Transmitter Interface Board (TIB) receives the MPU address and data bus signals from the Transmitter Site Controller (TSC) and converts them into data and control signals that are used by the Trunked Radio System base repeater transmitters. Each TIB can control up to seven transmitters, therefore, three TIB modules are required for a 20–channel system and four modules for a 28–channel system. Refer to the schematic diagram, as required, during the following detailed description of the TIB.

2. THEORY OF OPERATION

2.1 SIGNAL BUFFERS

Inverting bidirectional buffer U1 receives all data signals from the TSC data bus (__D0 - __D7). Inverting buffer U2 receives address lines __A0, __A1, __A2, __A5, __A8, and __ADEC. The inverting buffer U3 receives the signals __R/W, __E, __TEST, __RESET, and __3600. The data signals (D0 – D7), the address signals (A0 – A2), R/__W, E, and RESET signals are then fed into PIAs U7 and U8. The signals A5, A8, and ADEC are primarily used in the address decoder along with E and R/__W signals. A0 and A1 appear at PIA U7 (pins 36 and 35 respectively) and appear at PIA U8 (pins 35 and 36 respectively). These connections will put the output register of U8 in adjacent memory locations and permits the transfer of two bytes of information to the U8 outputs with one STORE INDEX instruction. The A2 signal is also connected to both PIAs U7 and U8 and are primarily used for chip selection (U7 is selected when A2 is low and U8 is selected when A2 is high).

2.2 ADDRESS DECODING

Address decoding is required since there are more address lines than there are chip select inputs on PIAs U7 and U8. In addition, the bidirectional buffer U1 must be switched either to enable data to be read by the MPU or write data from MPU. As mentioned earlier, the signals A5, A8, ADEC, E, and R/__W are used by the address decoder. A5, A8, ADEC signals reside at U4A (pins 2, 1, and 13 respectively) and are fed into U4B along with E (pins 4 and 5 respectively) then inverted through U5 (pin 13) and is fed into U1 (pin 19). If any of these signals differ from a logical 1, then the data buffer U1 is isolated, otherwise U1 is enabled. Signal R/__W is routed directly to U1 directional pin. When R/W is high and U1 is enabled, then data is read from the TSC. When R/W is low U1 is enabled, then data is written from the TSC to the PIAs.

Since a Trunked Radio System can be provided with up to four TIB modules, each TIB requires its own address. This is done on the central controller backplane by connecting different address lines to edge connector pin 40. For TIB1, edge pin 40 is connected to address line __A5. For TIB2, pin 40 is connected to __A6. For TIB3, pin 40 is connected to __A7. For TIB4 (28–channel systems), pin 40 is connected to __A11.

2.3 PIA OPERATIONS

The B side of U7 controls the state of the seven yellow LED indicators (DS1 - DS7). The A side of U7 receives inputs either from the transmitter status (TSTAT) or from the ENABLE/DISABLE switches (S1 – S7). The PB7 signal at U7 side B controls the U10 and U11 MUX to select the inputs at U7 side A.

The U8 outputs are connected to inverters U12 and U13 and is then applied to the U17 – U23 parallel–to–serial converters and to the U24 – U30 D–latches.

The CB2 output of U8 drives 4–bit counter U15. Output bits QA, QB, and QC are fed into the decoder U16. U16 decodes the 3–line inputs into eight output lines. The outputs are then routed into different pairs of parallel–to–serial converters and different pairs of latches. Whenever data is read into U7, the pulse CA2 (which is generated by U7) clears U15. When data is written to the B side of U8, the positive pulse CB2 (which is generated by U8) is clocked into U15 and increments U15 by one unit. Inversely, CB2 disables U16 while U15 is changing state.

2.4 DATA GENERATION AND CONTROL

A 3600 Hz signal is applied to each parallel–to–serial converter (U17 – U23). The data in the converters is shifted one stage with each 0 to 1 transition of the clock. During this initial transition, the A side of U7 is read which in turn generates a CA2 pulse that clears U15. Consequently, U16 decodes the information from U15 and causes Y0 to go low while Y1 – Y7 remain high. Since Y0 of U16 is connected to the pair U17 and U18, a low Y0 causes U17 and U18 to accept signals on the parallel inputs. Information

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technical writing services
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is now written out to both sides A and B of U8, through U12 and U13, and fed into the rest of the converters (U19 – U23). This action generates a pulse CB2 from U8 and advances U15 by a count. U16 decodes the information and sets Y1 low while the other outputs remain high. Y1 is connected to the pair U19 and U20 and enables U19 and U20 to accept the next output signals from U8. Information is fed into U21, U22, and U23 in the similar fashion. When U15 is set to count of four, data is latched into the first pair of latches U24 and U25. Information is fed into the remainder latches U26 –U30 in the same fashion. During the second through the sixth clock cycles, no information is written out to U8. However, with each 0 to 1 transition of the clock, information is shifted within U17 through U23 and shifted out of their respective outputs. Information in U24 through U30 do not change. During the seventh cycle of the 3600 Hz clock, signals are again fed into U8.

2.5 DATA BAUD RATES

Data is transmitted at three different baud rates. The Connect signal is transmitted at 150 baud, the disconnect signal is transmitted at 300 baud, and the high speed signal at 3600 baud. Since the TIB has only one clock signal (3600 Hz), the transmission of the slower baud rate is achieved by writing out data to PIA U8 at the proper times to correspond to the slower baud rate.

2.6 DATA FILTER

The two paths (high speed and low speed) are centered at zero independently before the summer–amplifier stage. For channel 1 for instance, the low speed data output is applied through U31–11 and U31–15 into pullup and pulldown resistors R31 and R32 and is fed into the low pass filter (C1, C2, C3, C4, C9, C10, C11, C12, R34, R35, R37, R42, and R44). This data is now attenuated and centered at zero. Summer–amplifier stage U32D provides the correct gain (R66/R65) and generates a level of 2.93 volts p–p. Again for channel 1, the high speed data output is applied through U31–12 and U32–14, into pullup and pulldown resistors R33 and R36 and is fed into the difference amplifier (U32D). This data is centered at zero and a has a level of 8.8 ±0.4 volts p–p. Channels 2 through 7 have the same circuitry.

2.7 FILTER CONTROL AND DATA OUT

Data from the data shift register is inverted and fed into a demultiplexer where it is switched to the proper output. For channel 1 for instance, analog switch U31 is controlled by L/L and H/L signals. The upgrade version (TRN8663B) TIB requires only one filter; therefore, the switch outputs 02 and 03 are connected and are routed to jumper JU1 (to by–pass filter when using older version simulcast software).

2.8 PTT AND MUTE OUTPUT

The outputs U17 through U30 generate five outputs per each channel; DATA, PTT, MUTE, H/L, and L/L. DATA signals are generated from U17 through U23 and is sent to the filter circuitry. The other four signals are generated by U24 through U30. For channel 1 for instance, PTT is then fed into inverter U45 and into two dip switches, S8 and S9 (this is for the "Fake Out" capability). When U8 is closed, it allows the PTT signal to route through diode CR1 and into TSTAT beyond U59.

When S9 is closed, it allows PTT through U60 and out to edge connection pin 31. TRN8663B is hardware equipped to accommodate a Simulcast Mixed System (per–channel, dual–path operations). For example, with channel 1 configured as a dual path channel in a Simulcast Mixed System, the MUTE signal is fed into jumper JU3 pin A (this gives the option to jumper H/L into the MUTE buffer circuitry), then fed through U61 into inverter U45, and finally into edge connector pin 30. Also JU1 is configured in the B position to enable low speed data to jump into the high speed data path, bypass the filter circuitry, and then feed into edge connector pin 28. The jumper configurations are shown in Table 1.

2.9 FRONT PANEL

Each TIB front panel is provided with a green **Xmit** LED indicator, a yellow **Disabled** LED indicator, and an enable/disable switch for each channel controlled by the TIB. When lit, the green LED indicates that the transmitter key lead is active on the associated channel. The yellow LED indicates the associated channel is disabled. A channel is disabled by pushing the associated switch to the in position, is a enabled by releasing to the out position. The switch has no effect unless the key switch on the TSC is set to the **Service Enable** position.

Table 1. TIB Jumper Configurations

Channel	Jumper	*Non–dual Path	Mixed (Dual Path)
1	JU1	B	A
1	JU3	A	B
2	JU2	B	A
2	JU4	A	B
3	JU5	B	A
3	JU7	A	B
4	JU6	B	A
4	JU8	A	B
5	JU9	B	A
5	JU11	A	B
6	JU10	B	A
6	JU12	A	B
7	JU13	B	A
7	JU14	A	B

* Standard jumper configuration
NOTE: Dip switch S9 is ON and S8 is OFF for standard operation.

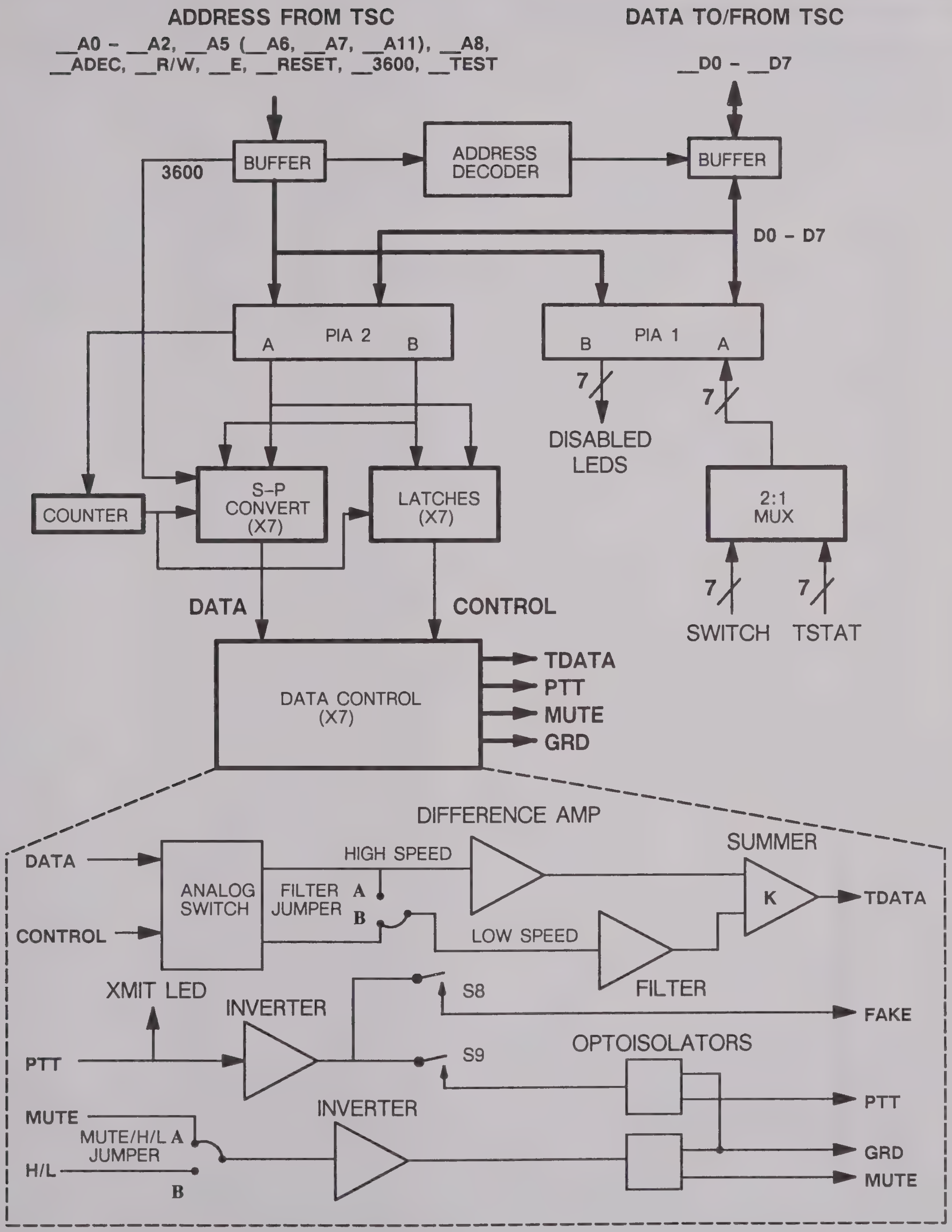

ADDRESS FROM TSC
__A0 – __A2, __A5 (__A6, __A7, __A11), __A8,
__ADEC, __R/W, __E, __RESET, __3600, __TEST
DATA TO/FROM TSC
__D0 – __D7
BUFFER
3600
ADDRESS DECODER
BUFFER
D0 – D7
PIA 2
A
B
PIA 1
B
A
7
DISABLED LEDS
7
COUNTER
S–P CONVERT (X7)
LATCHES (X7)
2:1 MUX
7
7
SWITCH
TSTAT
DATA
CONTROL
DATA CONTROL (X7)
TDATA
PTT
MUTE
GRD
DIFFERENCE AMP
SUMMER
DATA
CONTROL
ANALOG SWITCH
HIGH SPEED
FILTER JUMPER
A
B
LOW SPEED
K
TDATA
FILTER
XMIT LED
INVERTER
S8
FAKE
S9
OPTOISOLATORS
PTT
PTT
MUTE
MUTE/H/L JUMPER
A
B
H/L
INVERTER
GRD
MUTE

Figure 1. *TRN8663B Transmitter Interface Board (TIB) Block Diagram*

PL-11645-O

IPTION

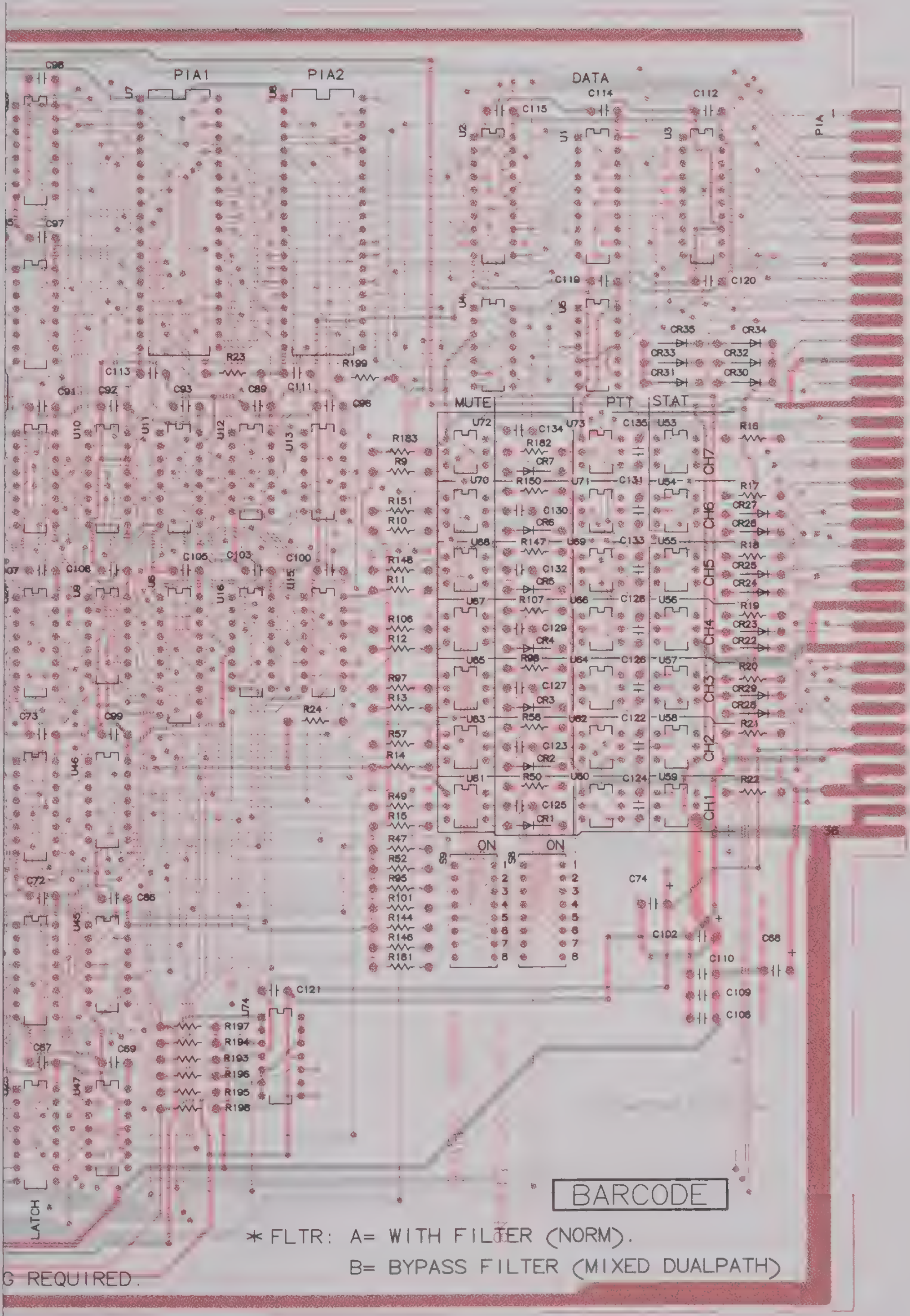
±5% 50V
d

(see note)

% 1/4W
d

TRN8663B TRANSMITTER INTERFACE BOARD

CIRCUIT BOARD DETAIL AND PARTS LIST


PIA1
PIA2
DATA
P1A
C98
C97
C115
C114
C112
U7
U8
U2
U1
U3
C119
C120
U4
U5
CR35
CR34
CR33
CR32
CR31
CR30
C113
R23
R199
C111
C91
C92
C93
C89
C96
MUTE
PTT
STAT
U10
U11
U12
U13
R183
R9
U72
C134
R182
CR7
U73
C135
U53
R16
CH7
U70
R150
U71
C131
U54
R17
CR27
CR26
CH6
R151
R10
C130
CR6
U68
R147
U69
C133
U55
R18
CR25
CR24
CH5
C108
C105
C103
C100
R148
R11
C132
CR5
U6
U16
U15
U67
R107
U66
C128
U56
R19
CR23
CR22
CH4
R106
R12
C129
CR4
U65
R98
U64
C126
U57
R20
CR29
CR28
CH3
R97
R13
C127
CR3
R24
C73
C99
U63
R58
U62
C122
U58
R21
CH2
R57
R14
C123
CR2
U46
U61
R50
U60
C124
U59
R22
CH1
R49
R15
C125
CR1
36
R47
ON
ON
S9
S8
1
2
3
4
5
6
7
8
R52
R95
R101
R144
R146
R181
C72
C86
C74
U45
C102
C88
C110
C121
C109
C106
U74
R197
R194
R193
R196
R195
R198
C87
C69
U47
BARCODE
LATCH

* FLTR: A= WITH FILTER (NORM).
B= BYPASS FILTER (MIXED DUALPATH)

G REQUIRED.

NT SIDE ● BD-CEPS-47988-0
DER SIDE ● BD-CEPS-47989-0
OL-CEPS-47990-0

TRN8663B TRANSMITTER INTERFACE BOARD

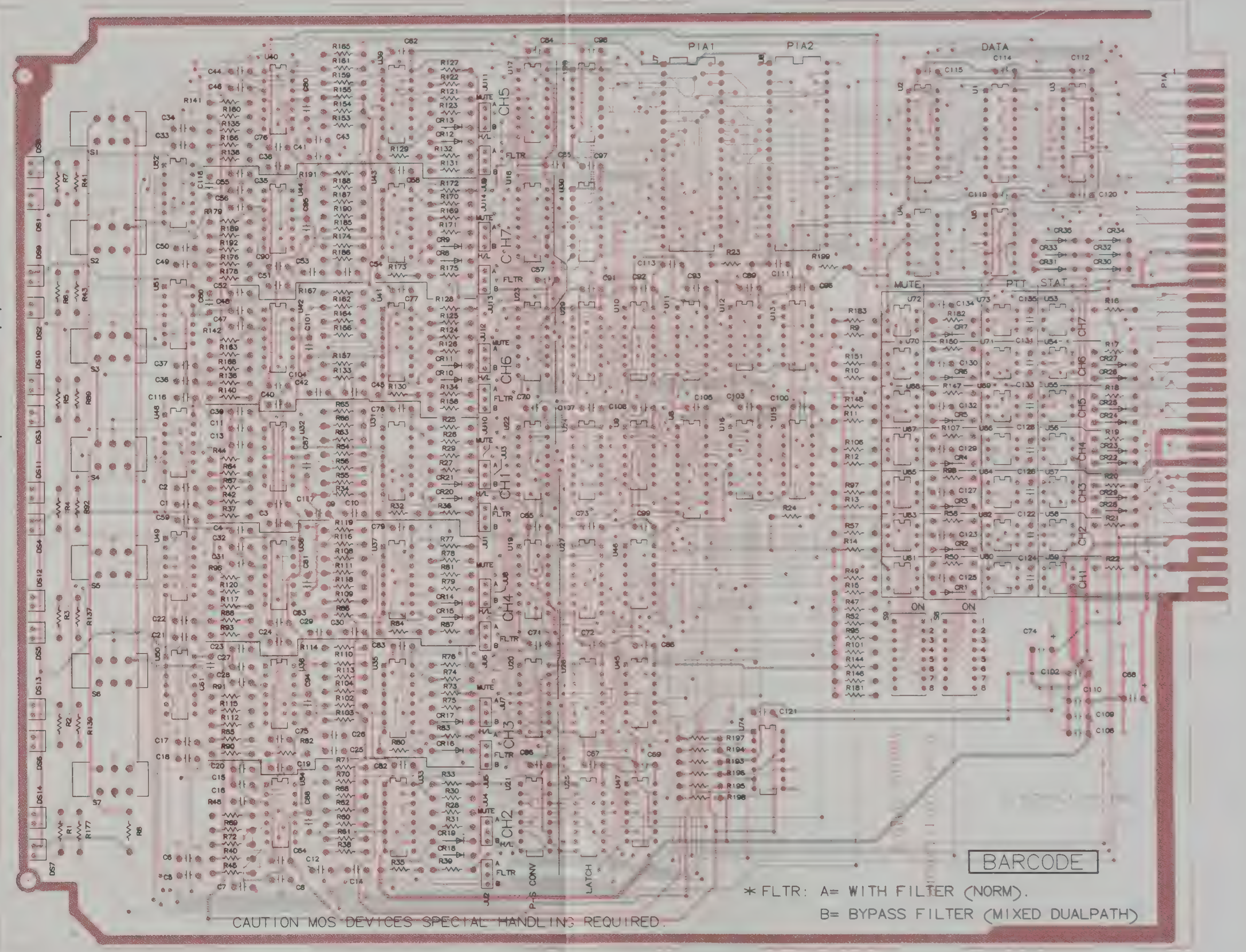
CIRCUIT BOARD DETAIL
AND PARTS LIST

parts list

TRN8663B Transmitter Interface Board PL-11645-O

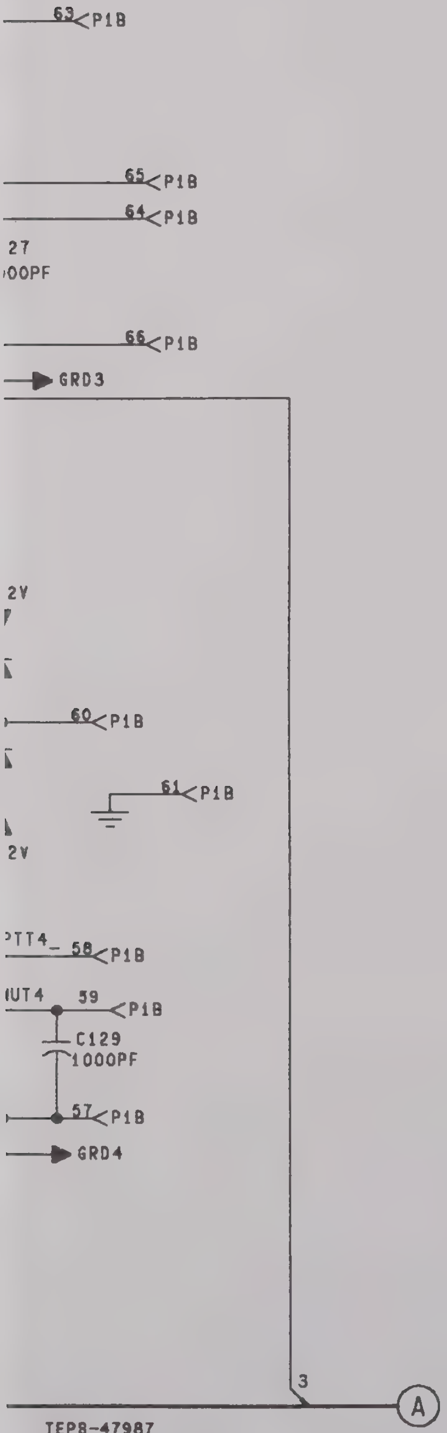
REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitor, fixed; uF: ±5% 50V unless otherwise stated
C1 ,2	0811017A08	.01
C3	0811017A01	.001
C4	0811017A03	.0022
C5,6	0811017A08	.01
C7	0811017A01	.001
C8	0811017A03	.0022
C9	0811051A08	.015 63V
C10	0811017A06	.0047
C11	0811017A01	.001
C12	0811051A08	.015 63V
C13	0811017A03	.0022
C14	0811017A06	.0047
C15	0811017A01	.001
C16	0811017A03	.0022
C17,18	0811017A08	.01
C19	0811017A01	.001
C20	0811017A03	.0022
C21,22	0811017A08	.01
C23	0811017A01	.001
C24	0811017A03	.0022
C25	0811051A08	.015 63V
C26	0811017A06	.0047
C27	0811017A01	.00 1
C28	0811017A03	.0022
C29	0811051A08	.015 63V
C30	0811017A06	.0047
C31	0811017A01	.001
C32	0811017A03	.0022
C33,34	0811017A08	.01
C35	0811017A01	.001
C36,37	0811017A08	.01
C38	0811017A03	.0 022
C39	0811017A01	.001
C40	0811017A03	.0022
C41,42	0811051A08	.015 63V
C43	0811017A06	.0047
C44	0811017A01	.001
C45	0811017A06	.0047
C46	0811017A03	.0022
C47	0811017A01	.001
C48	0811017A03	.0022
C49,50	0811017A08	.01
C51	0811017A01	.001
C52	0811017A03	.0022
C53	0811051A08	.015 63V
C54	0811017A06	.0047
C55	0811017A01	.001
C56	0811017A03	.0022
C57 thru 67	0811051A13	0.1 63V
C68	2311019A46	100 ± 20% 25V
C69 thru 73	0811051A13	0.1 63V
C74	2311019A46	100 ± 20% 25V
C75 thru 101	0811051A13	0.1 63V
C102	2311019A46	100 ± 20% 25V
C103 thru 121	0811051A13	0.1 63V
C122 thru 135	2111015B13	.001 ± 10% 100V
		diode (see note):
CR1 thru 35	4883654H01	silicon
		light emitting diode: (see note)
DS1 thru 7	4888245C23	yellow
DS8 thru 14	4888245C22	green
		jumper:
JU1 thru 14	2880001R03	male: 3-contact
		resistor, fixed: ±0.5% 1/4W unless otherwise stated
R1 thru 7	0611009A39	390 ±5%
R8	0611009A49	1k ±5%
R9 thru 15	0611009A73	10k ±5%
R16 thru 22	0611009A58	2.4k ±5%
R23 thru 26	0611009A61	3. 3k ±5%
R27	0611009A73	10k ±5%
R28 thru 30	0611009A61	3.3k ±5%
R31	0611009A73	10k ±5%
R32	0611040D91	107k
R33	0611009A61	3.3k ±5%
R34	0611040E39	332k
R35 thru 37	0611040D91	107k
R38	0611040E39	332k
R39,40	0611040D91	107k
R41	0611009A41	470 ±5%
R42	0611040E43	365k
R43	0611009A41	470 ±5%
R44,4 5	0611040E43	365k
R47	0611009A73	10k ±5%
R48	0611040E43	365k
R49,50	0611009A33	220 ±5%
R52	0611009A73	10k ±5%
R54	0611040E08	158k
R55	0611040D76	75k
R56	0611040D91	107k
R57,58	0611009A33	220 ±5%
R60	0611040E08	158k
R61	0611040D76	75k
R62	0611040D91	107k
R63	0611040C20	1.82k
R64	061104 0C79	7.5k
R65	0611040B94	1k
R66	0611040C20	1.82k
R67	0611040C68	5.76k
R68	0611040C20	1.82k
R69	0611040C79	7.5k
R70	0611040B94	1k
R71	0611040C20	1.82k
R72	0611040C68	5.76k
R73,74	0611009A61	3.3k ±5%
R75	0611009A73	10k ±5%
R76 thru 78	0611009A61	3.3k ±5%
R79	0611009A73	10k ±5%
R80	0611040D91	107k
R81	0611009A61	3.3k ±5%
R82	0611040E39	332k
R83 thru 85	0611040D91	107k
R86	0611040E39	332 k
R87,88	0611040D91	107k
R89	0611009A41	470 ±5%
R90,91	0611040E43	365k
R92	0611009A41	470 ±5%
R93	0611040E43	365k
R95	0611009A73	10k ±5%
R96	0611040E43	365k
R97,98	0611009A33	220 ±5%
R101	0611009A73	10k ±5%
R102	0611040E08	158k
R103	0611040D76	75k
R104	0611040D91	107k
R106,107	0611009A33	220 ±5%
R108	0611040E08	158k
R109	0611040D76	75k
R110	0611040C20	1.82k
R111	0611040D91	107k
R112	0611040C79	7.5k
R113	0611040B94	1k
R114	0611040C20	1.82k
R115	0611040C68	5.76k
R116	0611040C20	1.82k
R117	0611040C79	7.5k
R118	0611040B94	1k
R119	0611040C20	1.82k
R120	0611040C68	5.76k
R121,122	0611009A61	3.3k ±5%
R123	0611009A73	10k ±5%
R124,125	0611009A61	3.3k ±5%
R126	0611009A73	10k ±5%
R127,128	0611009A61	3.3k ±5%
R129,130	0611040D91	107k
R131	0611040E39	332k
R132	0611040D91	107k
R133	0611040E39	332k
R134 thru 136	0611040D91	107k
R137	0611009A41	470 ±5%
R138	0611040E43	365k
R139	0611009A41	470 ±5%
R140 thru 142	0611040E43	365k
R144	0611009A73	10k ±5%
R146	0611009A73	10k ±5%
R147,148	0611009A33	220 ±5%
R150,151	0611009A33	220 ±5%
R153	0611040E08	158k
R154	0611040D76	75k
R155	0611040D91	107k
R156	0611040E08	158k
R157	0611040D76	75k
R158	0611040D91	107k
R159	0611040C20	1.82k
R160	0611040C79	7.5k
R161	0611040B94	1k
R162	0611040C20	1.82k
R163	0611040C79	7.5k
R16 4	0611040B94	1k
R165	0611040C20	1.82k
R166	0611040C68	5.76k
R167	0611040C20	1.82k
R168	0611040C68	5.76k
R169,170	0611009A61	3.3k ±5%
R171	0611009A73	10k ±5%
R172	0611009A61	3.3k ±5%
R173	0611040D91	107k
R174	0611040E39	332k
R175,176	0611040D91	10 7k
R177	0611009A41	470 ±5%
R178,179	0611040E43	365 k
R181	0611009A73	10k ±5%
R182,183	0611009A33	220 ±5%
R185	0611040E08	158k
R186	0611040D76	75k
R187	0611040D91	107k
R188	0611040C20	1.82k
R189	0611040C79	7.5k
R190	0611040B94	1k
R191	0611040C20	1.82k
R192	0611040C68	5.76k
R193	0611040B99	1 .13k
R194	0611040B96	1.05k
R195	0611040B90	909
R196	0611040A97	100
R197,198	0611009A89	47k ±5%
R199	0611009A73	10k ±5%
		switch:
S1 thru 7	4084324C17	dpdt pushbutton
S8,9	4083022M03	8-position spst slide
		integrated circuit: (see note)
U1	5184810F34	octal bus inverted tristate transceiver
U2,3	5182369T05	line driver/receiver/transceiver
U4	5184118K40	3-input triple AND gate
U5	5182369T03	inverter
U6	5182369T05	line driver/receiver/transceiver
U7,8	5184437N40	PIA
U9	5184084D38	hex buffer/driver inverter
U10,11	5184118K43	2-input quad multiplexer
U12,13	5182369T03	inverter
U15	5184118K44	4-bit sync w/clear binary counter
U16	5184118K34	3-line to 8-line decoder
U17 thru 23	5184118K35	parallel load 8-bit shift register
U24 thru 30	5184118K25	quad D-type flip-flop
U31	5184887K67	analog multiplexer/demultiplexer
U32	5184621K21	quad operational amplifier
U33	5184887K67	analog multiplexer/demultiplexer
U34	5184621K21	quad operational amplifier
U35	5184887K67	analog multiplexer/demultiplexer
U36	5184621K21	quad operational amplifier
U37	5184887K67	analog multiplexer/demultiplexer
U38	5184621K21	quad operational amplifier
U39	5184887K67	analog multiplexer/demultiplexer
U40	5184621K21	quad operational amplifier
U41	5184887K67	analog mul tiplexer/demultiplexer
U42	5184621K21	quad operational amplifier
U43	5184887K67	analog multiplexer/demultiplexer
U44	5184621K21	quad operational amplifier
U45 thru 47	5184084D38	hex buffer/driver inverter
U48 thru 50	5184118K40	3-input triple AND gate
U51,52	5184118K41	positive quad 2-input NOR buffer
U53 thru 73	5184320A92	opto-coupler
U74	5184621K21	quad operational amplifier
	non-referenced items	
	0300136890	SCREW, locking: 4-40 0 9/32; 2 used
	0984728L01	CONNECTOR, socket: for JU1-JU14
	1484891E02	INSULATOR, standoff switch: for S1-S7
	3884683F01	PUSHBUTTON: for S1-S7
	4184891F01	SPRING
	4282506T01	RETAINER
	5483865R01	LABEL, bar code
	5582239K01	LATCH
	6484680F16	PANEL, transmitter interface

note: For optimum performance, diodes, transistors, and integrated circuits must be ordered by Motorola part numbers.


PIA1
PIA2
DATA
MUTE
PTT
STAT
CH1
CH2
CH3
CH4
CH5
CH6
CH7
FLTR
P-S CONV
LATCH
BARCODE
* FLTR: A= WITH FILTER (NORM).
B= BYPASS FILTER (MIXED DUALPATH)
CAUTION MOS DEVICES SPECIAL HANDLING REQUIRED.

SHOWN FROM COMPONENT SIDE

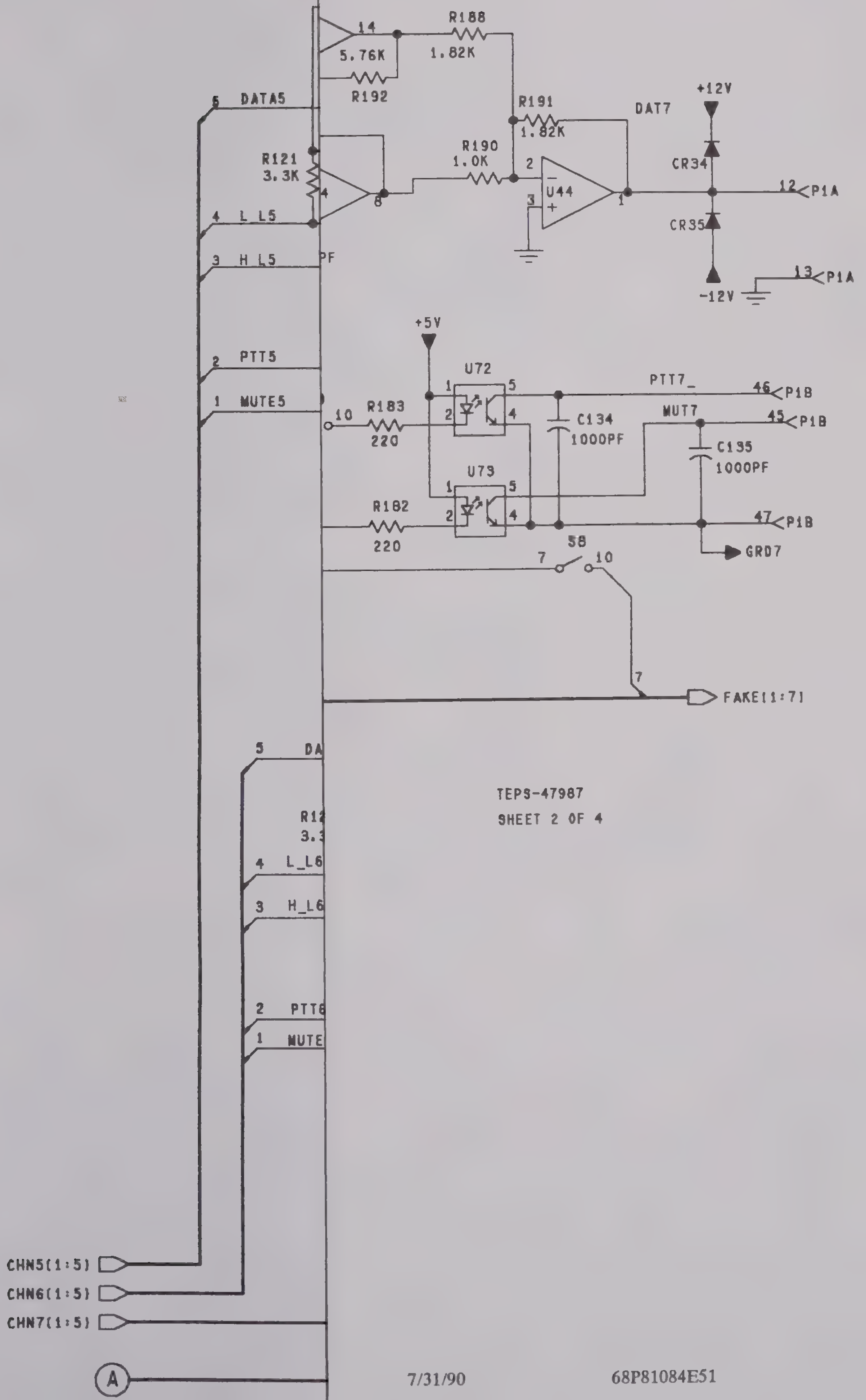
COMPONENT SIDE ■ BD-CEPS-47988-O
SOLDER SIDE ■ BD-CEPS-47989-O
OL-CEPS-47990-O


63 P1B
65 P1B
64 P1B
27
OOPF
66 P1B
GRD3
2V
60 P1B
61 P1B
2V
TT4 58 P1B
UT4 59 P1B
C129
1000PF
57 P1B
GRD4
3
A

TEP8-47987
SHEET 1 OF 4

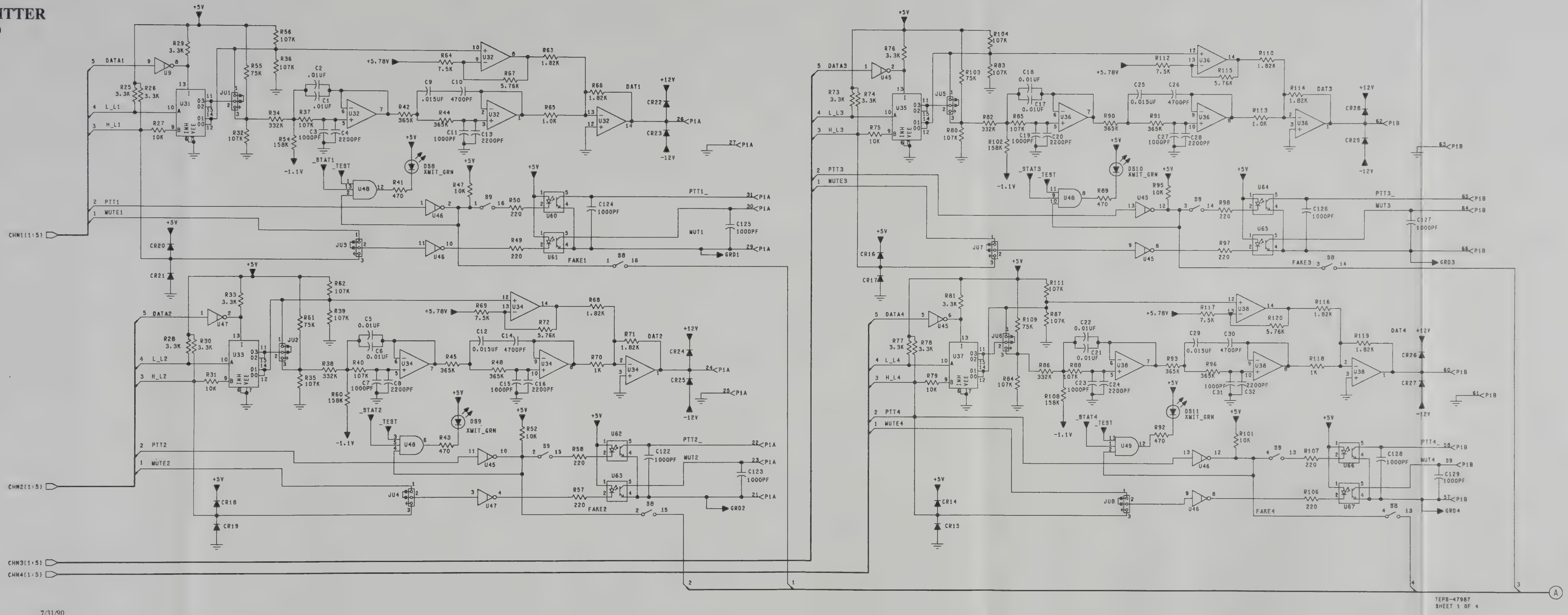
TRN8663B TRANSMITTER INTERFACE BOARD

LOGIC DIAGRAM


14
R188
5.76K
1.82K
R192
5 DATA5
R191
DAT7
+12V
1.82K
R190
R121
1.0K
3.3K
2
CR34
U44
4
8
3
1
12 P1A
4 L_L5
CR35
3 H_L5
PF
13 P1A
-12V
+5V
2 PTT5
U72
PTT7_
1 MUTE5
1
5
46 P1B
R183
MUT7
10
2
4
45 P1B
C134
220
1000PF
C135
1000PF
U73
1
5
R182
2
4
47 P1B
220
GRD7
58
7
10
7
FAKE[1:7]
5 DA
TEPS-47987
SHEET 2 OF 4
R12
3.3
4 L_L6
3 H_L6
2 PTT6
1 MUTE
CHN5(1:5)
CHN6(1:5)
CHN7(1:5)
A

TRN8663B TRANSMITTER INTERFACE BOARD

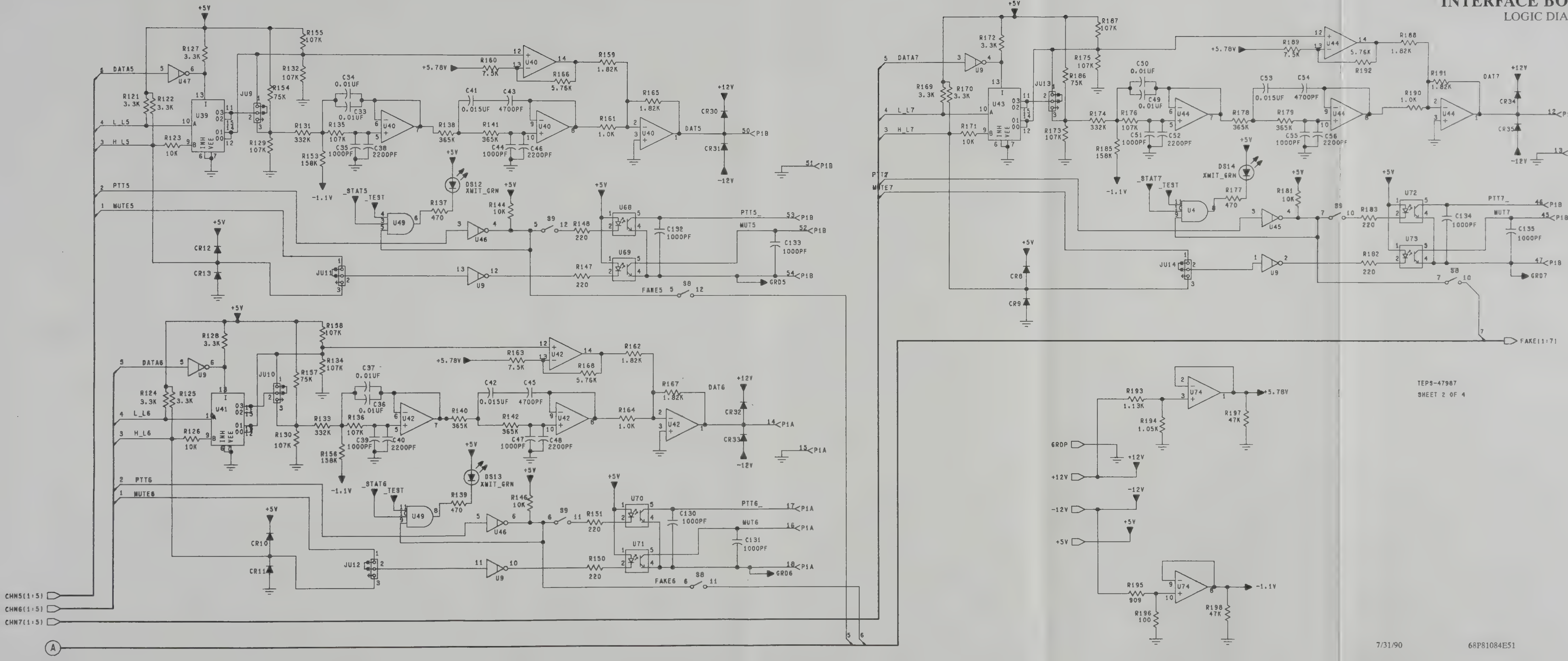
LOGIC DIAGRAM

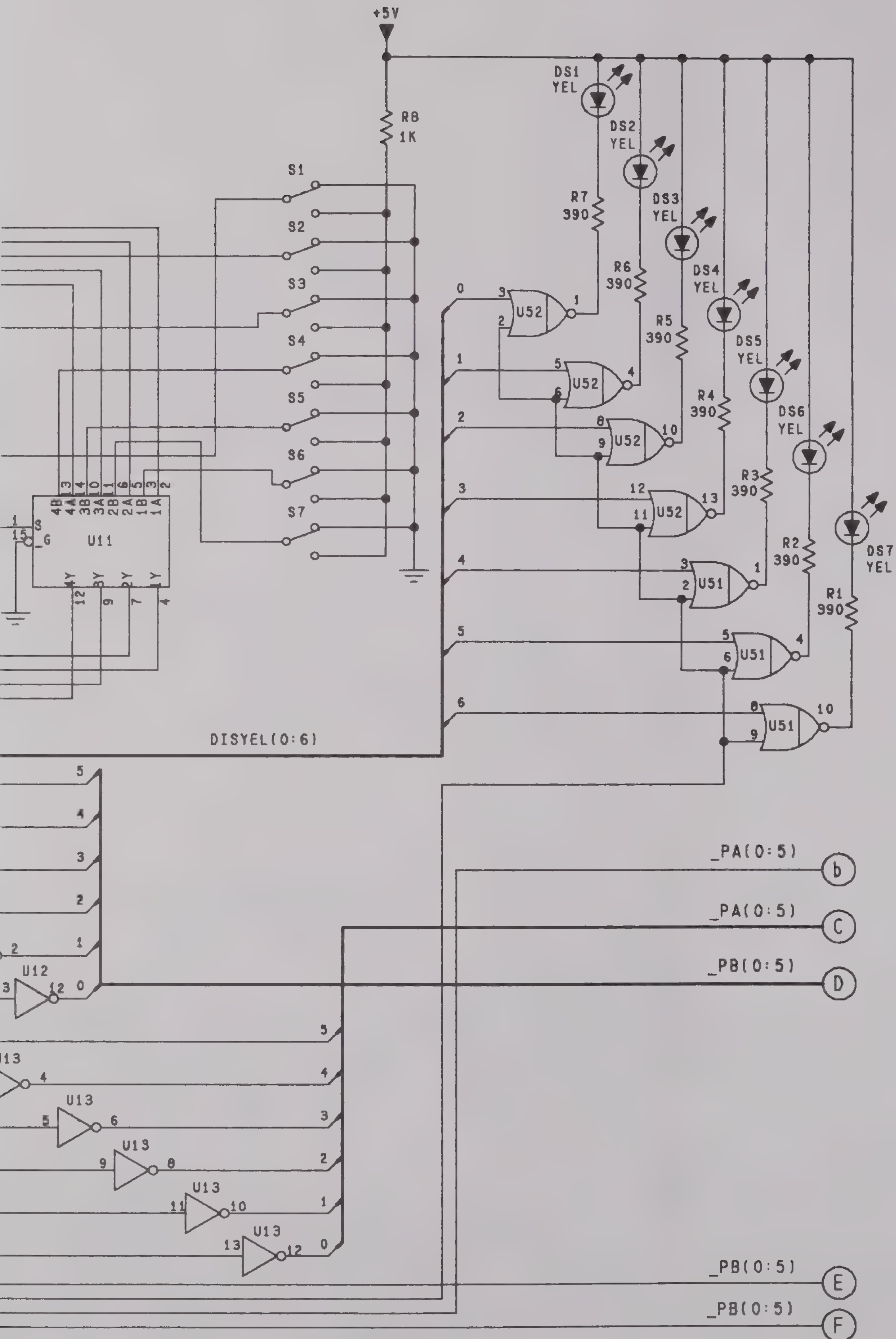


+5V
DATA1
DATA2
DATA3
DATA4
L_L1
H_L1
L_L2
H_L2
L_L3
H_L3
L_L4
H_L4
PTT1
MUTE1
PTT2
MUTE2
PTT3
MUTE3
PTT4
MUTE4
CHN1(1:5)
CHN2(1:5)
CHN3(1:5)
CHN4(1:5)
+5.78V
-1.1V
+12V
-12V
_STAT1
_STAT2
_STAT3
_STAT4
_TEST
DS8 XMIT_GRN
DS9 XMIT_GRN
DS10 XMIT_GRN
DS11 XMIT_GRN
DAT1
DAT2
DAT3
DAT4
PTT1_
MUT1
PTT2_
MUT2
PTT3_
MUT3
PTT4_
MUT4
FAKE1
FAKE2
FAKE3
FAKE4
GRD1
GRD2
GRD3
GRD4
P1A
P1B
S8
S9
JU1
JU2
JU3
JU4
JU5
JU6
JU7
JU8
U31
U32
U33
U34
U35
U36
U37
U38
U45
U46
U47
U48
U49
U9
U60
U61
U62
U63
U64
U65
U66
U67
A
TEPB-47987
SHEET 1 OF 4

TRN8663B TRANSMITTER INTERFACE BOARD

LOGIC DIAGRAM

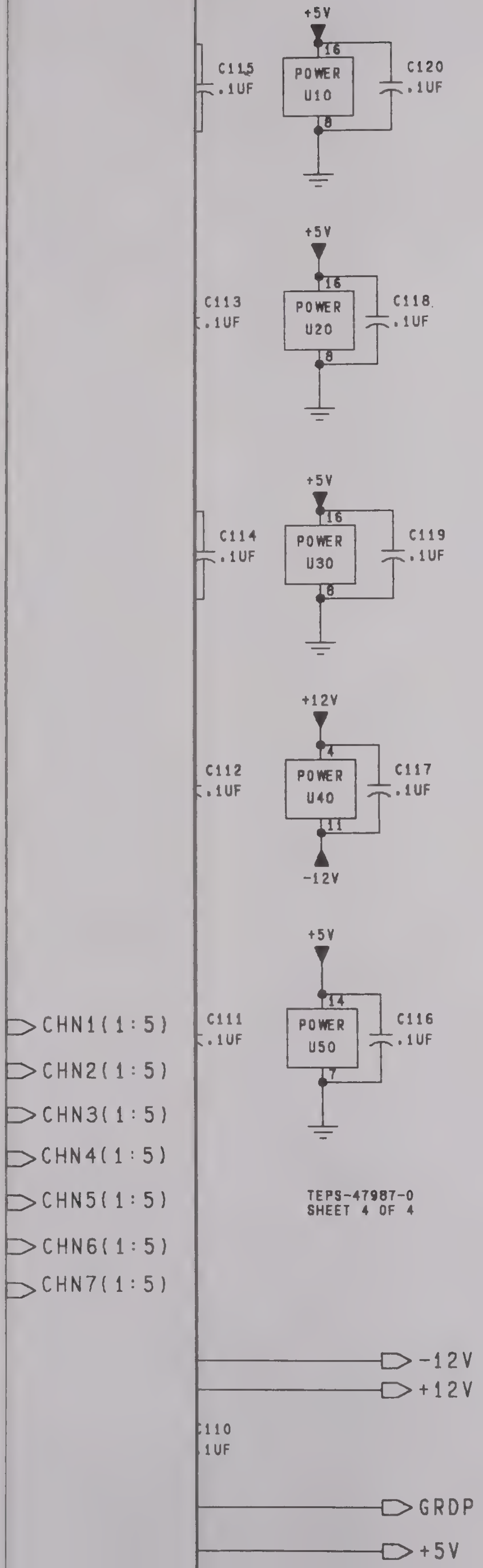

+5V
DATA5
U47
R127 3.3K
R121 3.3K
R122 3.3K
L_L5
H_L5
R123 10K
U39
JU9
R154 75K
R129 107K
R155 107K
R132 107K
C34 0.01UF
C33 0.01UF
R135 107K
R131 332K
R153 158K
C35 1000PF
C38 2200PF
U40
+5.78V
R160 7.5K
R166 5.76K
R159 1.82K
R138 365K
C41 0.015UF
C43 4700PF
R141 365K
C44 1000PF
C46 2200PF
R165 1.82K
R161 1.0K
DAT5
+12V
CR30
CR31
-12V
50 P1B
51 P1B
PTT5
MUTE5
-1.1V
DS12 XMIT_GRN
_STAT5
_TEST
U49
R137 470
R144 10K
U46
S9
R148 220
U68
C132 1000PF
PTT5_
53 P1B
MUT5
52 P1B
C133 1000PF
U69
R147 220
54 P1B
GRD5
FAKE5
S8
CR12
CR13
JU11
U9
DATA6
U9
R128 3.3K
R124 3.3K
R125 3.3K
L_L6
H_L6
R126 10K
U41
JU10
R157 75K
R158 107K
R134 107K
C37 0.01UF
C36 0.01UF
R136 107K
R133 332K
R130 107K
R156 158K
C39 1000PF
C40 2200PF
U42
R163 7.5K
R168 5.76K
R162 1.82K
R140 365K
C42 0.015UF
C45 4700PF
R142 365K
C47 1000PF
C48 2200PF
R167 1.82K
R164 1.0K
DAT6
CR32
CR33
14 P1A
15 P1A
PTT6
MUTE6
DS13 XMIT_GRN
_STAT6
_TEST
R139 470
R146 10K
R151 220
U70
C130 1000PF
PTT6_
17 P1A
MUT6
16 P1A
C131 1000PF
U71
R150 220
18 P1A
GRD6
FAKE6
CR10
CR11
JU12
CHN5(1:5)
CHN6(1:5)
CHN7(1:5)
A
DATA7
U9
R172 3.3K
R169 3.3K
R170 3.3K
L_L7
H_L7
R171 10K
U43
JU13
R187 107K
R175 107K
R186 75K
R173 107K
C50 0.01UF
C49 0.01UF
R174 332K
R176 107K
R185 158K
C51 1000PF
C52 2200PF
U44
R189 7.5K
R192 5.76K
R188 1.82K
C53 0.015UF
C54 4700PF
R178 365K
R179 365K
C55 1000PF
C56 2200PF
R191 1.82K
R190 1.0K
DAT7
CR34
CR35
12 P1A
13 P1A
PTT7
MUTE7
DS14 XMIT_GRN
_STAT7
_TEST
U4
R177 470
R181 10K
U45
R183 220
U72
C134 1000PF
PTT7_
46 P1B
MUT7
45 P1B
C135 1000PF
U73
R182 220
47 P1B
GRD7
CR8
CR9
JU14
FAKE(1:7)
R193 1.13K
R194 1.05K
U74
R197 47K
+5.78V
GRDP
+12V
-12V
+5V
R195 909
R196 100
R198 47K
-1.1V
TEPS-47987
SHEET 2 OF 4


+5V
R8
1K
S1
S2
S3
S4
S5
S6
S7
DS1
YEL
DS2
YEL
DS3
YEL
DS4
YEL
DS5
YEL
DS6
YEL
DS7
YEL
R7
390
R6
390
R5
390
R4
390
R3
390
R2
390
R1
390
U52
U52
U52
U52
U51
U51
U51
U11
4B
4A
3B
3A
2B
2A
1B
1A
S
_G
4Y
3Y
2Y
1Y
DISYEL(0:6)
U12
U13
U13
U13
U13
U13
_PA(0:5)
b
_PA(0:5)
C
_PB(0:5)
D
_PB(0:5)
E
_PB(0:5)
F

TEP8-47987
SHEET 3 OF 4

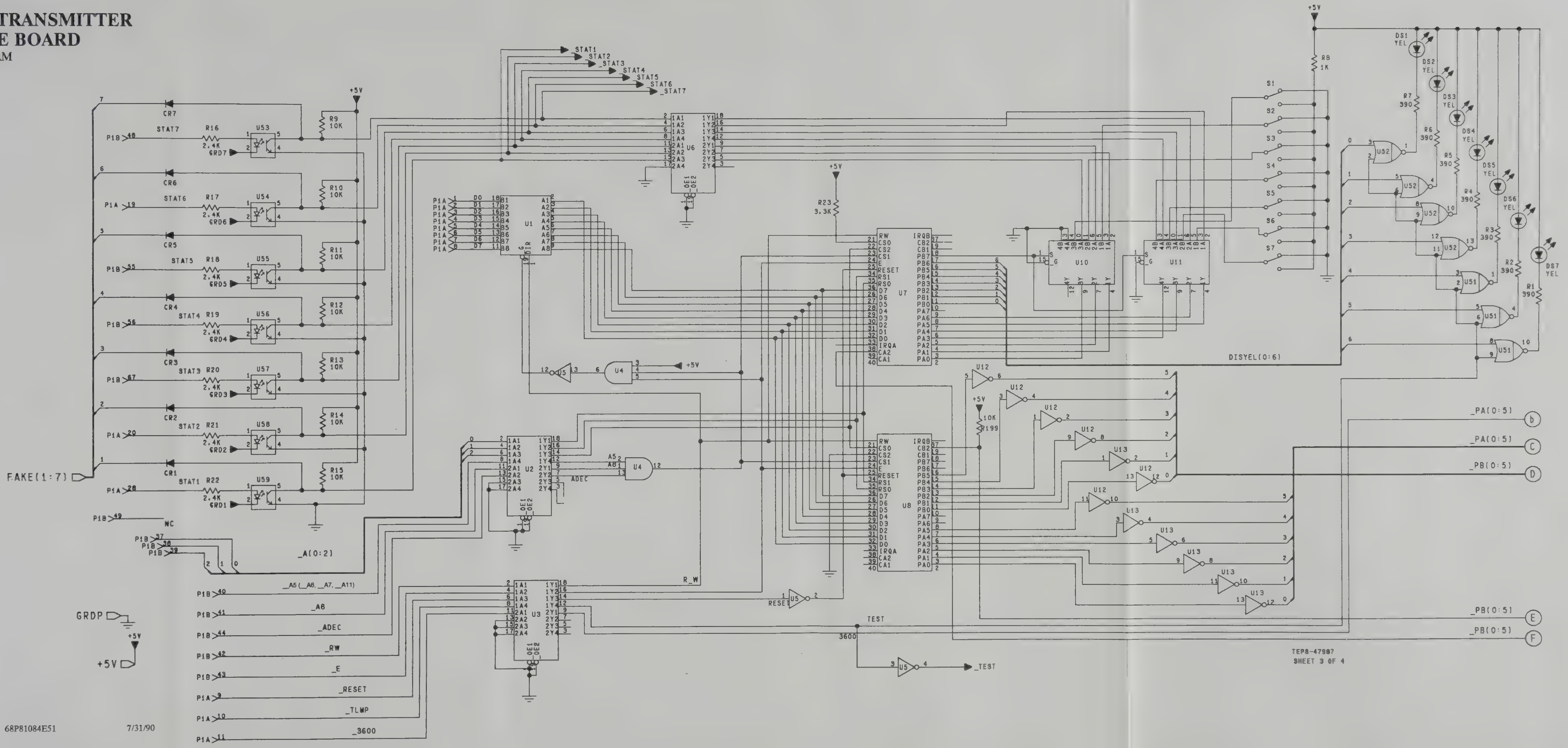
TRN8663B TRANSMITTER INTERFACE BOARD

LOGIC DIAGRAM


+5V
16
POWER
U10
8
C115
.1UF
C120
.1UF
+5V
16
POWER
U20
8
C113
.1UF
C118
.1UF
+5V
16
POWER
U30
8
C114
.1UF
C119
.1UF
+12V
4
POWER
U40
11
-12V
C112
.1UF
C117
.1UF
+5V
14
POWER
U50
7
C111
.1UF
C116
.1UF
CHN1(1:5)
CHN2(1:5)
CHN3(1:5)
CHN4(1:5)
CHN5(1:5)
CHN6(1:5)
CHN7(1:5)
TEPS-47987-0
SHEET 4 OF 4
-12V
+12V
C110
.1UF
GRDP
+5V

TRN8663B TRANSMITTER INTERFACE BOARD

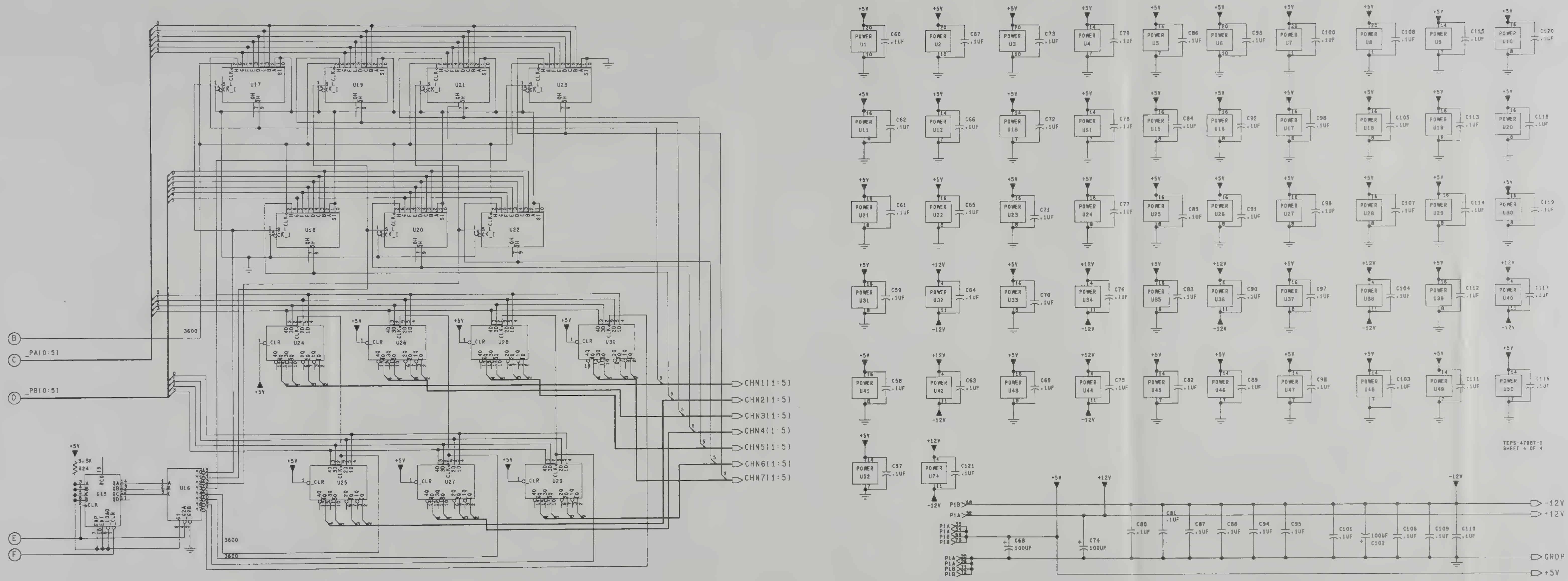
LOGIC DIAGRAM



STAT1
STAT2
_STAT3
STAT4
STAT5
STAT6
_STAT7
FAKE(1:7)
P1B 48
P1A 19
P1B 55
P1B 56
P1B 57
P1A 20
P1A 28
P1B 49
NC
P1B 37
P1B 38
P1B 39
_A(0:2)
U53
U54
U55
U56
U57
U58
U59
CR1
CR2
CR3
CR4
CR5
CR6
CR7
R16 2.4K
R17 2.4K
R18 2.4K
R19 2.4K
R20 2.4K
R21 2.4K
R22 2.4K
R9 10K
R10 10K
R11 10K
R12 10K
R13 10K
R14 10K
R15 10K
+5V
U6
U1
U2
U3
U4
U5
U7
U8
U10
U11
U12
U13
U51
U52
R23 3.3K
R199 10K
ADEC
R_W
RESET
TEST
3600
_TEST
P1B 40
_A5 (_A6, _A7, _A11)
P1B 41
_A8
P1B 44
_ADEC
P1B 42
_RW
P1B 43
_E
P1A 9
_RESET
P1A 10
_TLMP
P1A 11
_3600
GRDP
+5V
S1
S2
S3
S4
S5
S6
S7
R8 1K
DS1 YEL
DS2 YEL
DS3 YEL
DS4 YEL
DS5 YEL
DS6 YEL
DS7 YEL
R1 390
R2 390
R3 390
R4 390
R5 390
R6 390
R7 390
DISYEL(0:6)
_PA(0:5)
_PA(0:5)
_PB(0:5)
_PB(0:5)
_PB(0:5)
B
C
D
E
F
TEPB-47987
SHEET 3 OF 4

TRN8663B TRANSMITTER INTERFACE BOARD

LOGIC DIAGRAM


B
C
_PA(0:5)
D
_PB(0:5)
E
F
U17
U19
U21
U23
U18
U20
U22
U24
U26
U28
U30
U25
U27
U29
U15
U16
R24
3.3K
3600
CHN1(1:5)
CHN2(1:5)
CHN3(1:5)
CHN4(1:5)
CHN5(1:5)
CHN6(1:5)
CHN7(1:5)
POWER
P1B
P1A
C68
100UF
C74
100UF
C102
100UF
-12V
+12V
GRDP
+5V
TEPS-47987-0
SHEET 4 OF 4

MOTOROLA

Trunked Radio System
Central Controller
Privacy Plus™ Model T5004A
Privacy Plus™ Model T5152A
Smartnet™ Model T5076A

Instruction Manual

68P81066E60-C

COMMERCIAL WARRANTY
(STANDARD)

Motorola radio communications products are warranted to be free from defects in material and workmanship for a period of ONE (1) YEAR, (except for crystals and channel elements which are warranted for a period of ten (10) years) from the date of shipment. Parts, including crystals and channel elements, will be replaced free of charge for the full warranty period but the labor to replace defective parts will only be provided for One Hundred-Twenty (120) days from the date of shipment. Thereafter purchaser must pay for the labor involved in repairing the product or replacing the parts at the prevailing rates together with any transportation charges to or from the place where warranty service is provided. This express warranty is extended by Motorola Communications and Electronics, Inc., 1301 E. Algonquin Road, Schaumburg, Illinois 60196, to the original purchaser only, and only to those purchasing for purpose of leasing or solely for commercial, industrial, or governmental use.

THIS WARRANTY IS GIVEN IN LIEU OF ALL OTHER WARRANTIES EXPRESS OR IMPLIED WHICH ARE SPECIFICALLY EXCLUDED, INCLUDING WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. IN NO EVENT SHALL MOTOROLA BE LIABLE FOR INCIDENTAL OR CONSEQUENTIAL DAMAGES TO THE FULL EXTENT SUCH MAY BE DISCLAIMED BY LAW.

In the event of a defect, malfunction or failure to conform to specifications established by seller, or if appropriate, to specifications accepted by Seller in writing, during the period shown, Motorola, at its option, will either repair or replace the product or refund the purchase price thereof, and such action on the part of Motorola shall be the full extent of Motorola's liability hereunder.

This warranty is void if:

a. the product is used in other than its normal and customary manner;
b. the product has been subject to misuse, accident, neglect or damage;
c. unauthorized alterations or repairs have been made, or unapproved parts used in the equipment.

This warranty extends only to individual products, batteries are excluded, but carry their own separate limited warranty. Because each radio system is unique, Motorola disclaims liability for range, coverage, or operation of the system as a whole under this warranty except by a separate written agreement signed by an officer of Motorola.

Non-Motorola manufactured products are excluded from this warranty, but subject to the warranty provided by their manufacturers, a copy of which will be supplied to you on specific written request.

In order to obtain performance of this warranty, purchaser must contact its Motorola salesperson or Motorola at the address first above shown, attention Quality Assurance Department.

This warranty applies only within the United States.

EPS-27734-O

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EPS-34440-B

MOTOROLA INC.
Communications
Sector

TRUNKED RADIO SYSTEM CENTRAL CONTROLLER

PRIVACY PLUS MODEL T5004A
PRIVACY PLUS II MODEL T5152A
SMARTNET MODEL T5076A
SMARTNET II MODEL T5184A

CONTENTS

SECTION *NUMBER*

Commercial Warranty and Computer Software Copyrights .... inside cover
Foreword 68P81025E81
General Safety Information 68P81070E73
Specifications vii
Model Complement Charts .... viii,ix
Options Charts x

DESCRIPTION, INSTALLATION, AND MAINTENANCE

DESCRIPTION **68P81040E02**
1. Introduction .... Page 1
2. System Manager Capabilities .... Page 2
3. System User Call Capabilities .... Page 3
4. System Reliability Capabilities .... Page 3
5. System Access Features .... Page 4
6. Signaling .... Page 5
7. Equipment .... Page 5
8. Module Switches and Indicators .... Page 6

INSTALLATION **68P81066E58**
1. Inspection .... Page 1
2. Planning the Installation .... Page 1
3. Cabinet .... Page 1
4. Central Controller Circuit Board Modules .... Page 1
5. Interfacing to the Base Repeater Station .... Page 1
6. Alarm Indicators .... Page 3
7. Terminal Interface .... Page 3
8. Installing the System Manager Data Terminal .... Page 4
9. EPROM and PAL Installation in the CSC, RSC, and TSC Boards .... Page 4
10. Power Requirements .... Page 5
11. Remote Site Connections .... Page 6
12. Channels Logging Form .... Page 6
13. Racking and Cabling .... Page 6

Trunked Radio System Central Controller Hardware Parts List .... Page 10

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technical writing services
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SECTION *NUMBER*

SAFE HANDLING OF CMOS INTEGRATED CIRCUIT DEVICES **68P81106E84**

MAINTENANCE **68P81040E04**
1. System Test .... Page 1
2. Major Failure .... Page 2
3. Major Alarm .... Page 3
4. Minor Alarm .... Page 3
5. Busy Condition Processing .... Page 3
6. Voice Channel Call Processing .... Page 4

Trunked Radio System Troubleshooting Chart and Service Kit Parts List .... Page 7

CARD CAGE CHASSIS

21–CHANNEL CARD CAGE CHASSIS – MODEL TLN2016A **68P81046E94**
1. Description .... Page 1
2. Model Complement .... Page 1

Backplane Interconnect Board Detail and Parts List .... Page 4
Central Controller to Base Repeater Interconnecting Chart .... Page 6
Central Controller to Base Repeater and Equipment Interface .... Page 7
Central Controller to Equipment Interconnect Chart .... Page 8
Central Controller Intrasite and Intersite Connections .... Page 9
Central Controller to Base Repeater Trunked Control Cable Diagram, Connection Chart, and Parts List .... Page 10

MODULES

SITE CONTROLLER BOARD MODULES **68P81066E59**
1. Model Complement .... Page 1
2. Description .... Page 1
    - 2.1 Receiver Site Controller Board (RSC) Module .... Page 1
    - 2.2 Transmitter Site Controller Board (TSC) Module .... Page 1
    - 2.3 Central Site Controller Board (CSC) Module .... Page 1
    - 2.4 Site Audio Board (SAB) Module .... Page 2

SITE CONTROLLER BOARDS – MODEL TRN9725A/TRN9815A **68P81066E61**
1. Introduction .... Page 1
2. Microprocessor .... Page 1
3. Address Bus (A0–A15) .... Page 1
4. Data Bus (D0–D7) .... Page 2
5. Intrasite Clock .... Page 3
6. Intersite Clocks (3600 Hz, 600 Hz, and WFI) .... Page 3
7. Asynchronous Communication Interface Adapter (ACIA) .... Page 3
8. Memory (RAM and EPROM) .... Page 4
9. Parity Checker .... Page 5
10. Power Fail Detect ($\overline{\text{PFD}}$) .... Page 5
11. Battery Backup Charger .... Page 5
12. Watchdog Timer ("Tickle") .... Page 5
13. Reset .... Page 6
14. Major and Minor Alarms .... Page 6
15. Front Panel Switches (Disable, Reset, Test, Indicator Test, Alarm Cutoff Pushbuttons, Service Enable Key Switch) .... Page 6
16. Front Panel Indicators (Run, Disabled, Active, Failure, Alarm Cutoff) .... Page 7

SECTION *NUMBER*

Earlier Version Site Controller Board Circuit Board Detail .... Page 10
Earlier Version Site Controller Board Parts List .... Page 11
Earlier Version Site Controller Board Schematic Diagram .... Page 12
Current Version Site Controller Board Circuit Board Detail .... Page 14
Current Version Site Controller Board Parts List .... Page 15
Current Version Site Controller Board Schematic Diagram .... Page 16

INBOUND RECOVERY BOARD MODULE – MODEL TRN8662B 68P81040E09
  1. Introduction .... Page 1
  2. Functional Description .... Page 1
TRN8662B Receiver Interface Board Block Diagram, Circuit Board Detail, Logic Diagram and Parts List ... Page 5

RECEIVER INTERFACE BOARD MODULE – MODEL TRN8661A 68P81040E11
  1. Introduction .... Page 1
  2. Functional Description .... Page 1
  3. Front Panel .... Page 2
TRN8661A Receiver Interface Board Block Diagram, Circuit Board Detail, Logic Diagram and Parts List ... Page 3

TRANSMITTER INTERFACE BOARD MODULE – MODEL TRN8663A 68P81040E12
  1. Introduction .... Page 1
  2. Functional Description .... Page 1
TRN8663A Transmitter Interface Board Block Diagram, Circuit Board Detail, Logic Diagram and Parts List Page 5

ASYNCHRONOUS COMMUNICATIONS BOARD – MODEL TRN7056A 68P81125E55
  1. Introduction .... Page 1
  2. Addressing .... Page 1
  3. Board Settings .... Page 1
  4. Functional Description .... Page 1
TRN7056A Asynchronous Communications Board – Circuit Board Detail, Logic Diagram, and Parts List .... Page 5

SITE INTERFACE BOARD – MODEL TRN7124A 68P81125E56
  1. Description of Site Interface Board .... Page 1
  2. Circuit Description .... Page 1
  3. Functional Specifications .... Page 1
  4. Pinout Translation to Microwave .... Page 3
TRN7124A Site Interface Board – Circuit Board Detail, Logic Diagram, and Parts List .... Page 5

SITE AUDIO BOARD – MODEL TLN3099A 68P81125E57

POWER SUPPLY

POWER SUPPLIES – MODELS TPN6114A AND TPN6115A 68P81040E13
  1. Power Requirements .... Page 1
  2. Power Supply Adjustment .... Page 1
TPN6114A 5 V dc Power Supply Schematic Diagram and Parts List .... Page 3
TPN6115A ± 12 V dc Power Supply Schematic Diagram and Parts List .... Page 4

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FOREWORD

1. SCOPE OF MANUAL

This manual is intended for use by experienced technicians familiar with similar types of equipment. It contains all service information required for the equipment described and is current as of the printing date. Changes which occur after the printing date are incorporated by Instruction Manual Revisions (SMR). These SMR's are added to the manuals as the engineering changes are incorporated into the equipment.

2. MODEL AND KIT IDENTIFICATION

Motorola equipments are specifically identified by an overall model number on the nameplate. In most cases, assemblies and kits which make up the equipment also have kit model numbers stamped on them. When a production or engineering change is incorporated, the applicable schematic diagrams are updated.

3. SERVICE

Motorola's National Service Organization offers one of the finest nation-wide installation and maintenance programs available to communication equipment users. This organization includes approximately 900 authorized Motorola Service Stations (MSS) located throughout the United States, each manned by one or more trained, FCC licensed technicians.

These MSS's are independently owned and operated and were selected by Motorola to service its customers. Motorola maintenance is available on either a time and material basis or on a periodic fixed-fee type arrangement.

The administrative staff of this organization consists of national, area and district service managers and district representatives, all of whom are Motorola employees with the objective to improve the service to our customers.

Should you wish to purchase a service contract for your Motorola equipment, contact your Motorola Service Representative, or write to:

National Service Manager
Motorola Communications and Electronics, Inc.
1303 E. Algonquin Road
Schaumburg, Illinois 60196

REPLACEMENT PARTS ORDERING

ORDERING INFORMATION

Motorola maintains a number of parts offices strategically-located throughout the United States. These facilities are staffed to process parts orders, identify part numbers, and otherwise assist in the maintenance and repair of Motorola Communications Sector products.

Orders for all parts *except* crystals, active filters, channel elements, and Vibrasender and Vibrasponder resonant reeds should be sent to the nearest area parts center. Orders for instruction manuals should also be sent to the area parts center.

When ordering replacement parts or equipment information, the complete identification number should be included. This applies to all components, kits, and chassis. If the component part number is not known, the order should include the number of the chassis or kit of which it is a part, and sufficient description of the desired component to identify it.

Orders for crystals, channel elements, active filters, and reeds should be sent to the Component Product Sales & Service address listed below. Crystal and channel element orders should specify the crystal or channel element type number, crystal and carrier frequency, and the model number in which the part is used.

Orders for active filters, Vibrasender and Vibrasponder resonant reeds should specify type number and frequency, should identify the owner/operator of the communications system in which these items are to be used; and should include any serial numbers stamped on the components being replaced.

COMPONENT PRODUCT SALES & SERVICE OFFICE
(crystals, active filters, channel elements and reeds)

All Mail Orders
Motorola, Inc.
Component Product Sales & Service
P.O. Box 66191, O'Hare International Airport
Chicago, IL 60666

Correspondence
Motorola, Inc.
Component Product Sales & Service
2553 N. Edgington Street, Franklin Park, IL 60131
Tel: 312-451-1000, TWX: 910-227-0799

AREA PARTS OFFICES

Western Area Parts
1170 Chess Drive, Foster City, CA 94404
Tel: 415-349-3111, TWX: 910-375-3877

Pacific-Southwestern Area Parts
P.O. Box 85036, San Diego, CA 92138
Street Address:
9980 Carroll Canyon Road, San Diego, CA 92131
Tel: 619-578-8030, TWX: 910-335-1633

Gulf States Area Parts
P.O. Box 73115, 1140 Cypress Station, Houston, TX 77090
Tel: 713-537-3636, TWX: 910-881-6392

Southwestern Area Parts
P.O. Box 819049, 3320 Belt Line Road, Dallas, TX 75234
Tel: 214-888-6777, TWX: 910-860-5505

Midwest Area Parts
1313 E. Algonquin Rd., Schaumburg, IL 60196
Tel: 312-576-7430, TWX: 910-693-0869

Southeastern Area Parts
P.O. Box 368, Decatur, GA 30031
Street Address:
5096 Panola Industrial Blvd., Decatur, GA 30031
Tel: 404-987-2232, TWX: 810-766-0876

Rocky Mountain Area Parts
20 Inverness Place East, Englewood, CO 80112
Tel: 303-790-2323, TWX: 910-935-0785

East Central Area Parts
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Tel: 216-433-1560, TWX: 810-427-9424

Eastern Area Parts
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Tel: 201-670-9673, TWX: 710-988-5614

Mid-Atlantic Area Parts
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Tel: 301-796-8763, TWX: 710-862-1941

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Railroad, Airlines, and Telephone Sales
1313 E. Algonquin Rd., Schaumburg, IL 60196
Tel: 312-576-6520, TWX: 910-693-0869

All Canadian Orders
Motorola, Ltd., National Parts Department
3125 Steeles, Ave. E., North York, Ontario M2H 2H6
Tel: 416-499-1441, TWX: 610-491-1032,
Telex: 06-526258

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1171 West 17th Street, Tempe, AZ 85281
Tel: 602-994-6472, TWX: 910-951-1334

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Motorola, Inc., International Parts Department
1313 E. Algonquin Rd., Schaumburg, IL 60196. U.S.A.
Tel: 312-576-7241, TWX: 910-693-0869
Telex: 722443, Cable: MOTOL PARTS

GENERAL SAFETY INFORMATION

When installing the cental controller, please adhere to the following warning.

WARNING

Open rack mounting of the equipment is not recommended because of exposed 120 volt ac wiring to the power supplies.

SPECIFICATIONS

GENERAL

Model	T5076A, T5004A,T5152A, and T5184A Trunked Radio System Central Controller
Power Requirements	Input Voltage: 97–145 volts ac Current: 4 amperes, 50–60 Hz
Humidity	Noncondensing 90% at 50°C
Temperature Range	-30°C to +60°C (-22°F to +142°F)
Alarms	Major and minor alarm screw terminal closures are provided. Contact Rating: 10 watts dc 0.1 amperes maximum 28 volts maximum Contacts open to break the current path when an alarm condition exists.
Base Repeater Station Interface	The base repeater stations are connected tothe central controller via a 25–foot, 12–conductor cable that is provided with each base repeater station. The maximum allowable cable length is 100 feet.
Peripheral Interface	RS–232–C asynchronous interface
Duty Cycle	Continuous
Cabinet	60"H x 22"W x 19–1/4"D (1524mm x 559mm x 489mm)

MODEL COMPLEMENT CHART
for
TRUNKED RADIO SYSTEM
CENTRAL SITE CONTROLLER
EQUIPMENT

CODE

- ● = One Item Supplied
- 2 = Number of Items Supplied
- * = Refer to Item Breakdown Chart
- ** = Refer to Site Controller Board Instruction Section for Further Details

T5255A *Privacy Plus–Enhanced* Central Controller	T5241A Automatic Multiple Site Switching (AMSS) Remote Spares	T5240A AMSS Master Spares	T5209A *Smartnet II* Code Plug Reprogramming	T5187A AMSS Trunked Remote Site	T5186A AMSS *Smartnet II* Master Central Site Controller	T5185A *Smartnet II* Simulcast/ *Spectra-TAC* Trunked Remote Site	T5184A *Smartnet II* Central Controller	T5152A *Privacy Plus* Type II Central Controller	T5076A *Smartnet* Central Controller	T5004A *Privacy Plus* Central Controller	Item	Description
				●	2						BLN6731A	Punch Block
								●	●	●	TGN6124A	Blank Panels
●								●		●	THN6377A	Cabinet and Hardware Kit *(Privacy Plus)*
				●	●	●	●		●		THN6629A	Cabinet and Hardware Kit *(Smartnet)*
●				●	●	●	●	●	●	●	TKN8011A	AC Distribution Cable Kit
●				●	●	●	●	●	●	●	TKN8012A	DC Distribution Cable Kit
				2							TKN8582A	AMSS ACB Cable Kit
					7						TKN8583A	AMSS SIB Cable Kit
					●						TKN8592A	AMSS ACB/SIB Cable Kit
					2						TKN8877A	2–Foot RS–232 Cable Kit
										●	TLN2866A*	CCU Cardcage and Modules
									●		TLN2934A*	CCU Cardcage and Modules
								●			TLN3013A*	CCU Cardcage and Modules (Type II)
●	●	●		●	●		●				TLN3033A**	Type 2i Central Site Controller (CSC)
●	●			●			●				TLN3035A**	Type 2i Transmitter Site Controller (TSC)
●	●			●			●				TLN3036A**	Type 2i Receiver Site Controller (RSC)
						●					TLN3039A**	Type 2i Remote Site Controller (ReSC)
		●			●						TLN3040A**	Type 2i AMSS Data Concentrator Board (DCB)
		●			●						TLN3099A**	Site Audio Board (SAB)
3				3	3	3	3	3	3	3	TPN6114A	5 Vdc Power Supply
3				3	3	3	3	3	3	3	TPN6115A	12 Vdc Power Supply
	●	●		●							TRN7056A	Asynchronous Communications Board (ACB)
						●					TRN7068A	Remote Transmitter Interface Board (RTIB)
		●									TRN7124A	Site Interface Board (SIB)
●	●			●		●	●				TRN8661A	Receiver Interface Board (RIB)
●	●			●		●	●				TRN8662B	Inbound Recovery Board (IRB)
●	●			●			●				TRN8663A	Transmitter Interface Board (TIB)
●				●		●	●				TRN8664A	21–Channel Backplane Interconnect Board
●				●		●	●				TRN8665A	Cardcage Hardware Kit
●				●		●	●	●	●		TRN8693A	AC Power Distribution Box
●			●	●	●	●	●	●	●	●	TRN9194A	System Information
●	●	●	●	●	●		●				TVN6047A	Type 2i Codeplug Firmware

MAEPS–43301–B

ITEM BREAKDOWN CHART
for
TRUNKED RADIO SYSTEM
CENTRAL SITE CONTROLLER
EQUIPMENT

CODE

● = One Item Supplied

2 = Number of Items Supplied

*** = Refer to Cardcage Chassis Instruction Section for Further Details**

**** = Refer to Site Controller Board Instruction Section for Further Details**

Model			TLN3013A	TLN2934A	TLN2886A		
Description			*Privacy Plus* Type II CCU Cardcage and Modules	*Smartnet* CCU Cardcage and Modules	*Privacy Plus* CCU Cardcage and Modules		
						Item	**Description**
			●	●	●	TLN2016A*	21-Channel Cardcage Chassis
					●	TLN2997A**	*Privacy Plus* Central Site Controller Module (CSC)
				●	●	TLN3000A**	*Privacy Plus* Transmitter Site Controller Module (TWSC)
			●	●	●	TLN3001A**	*Privacy Plus* Receiver Site Controller Module (RSC)
				●		TLN3006A**	*Smartnet* Central Site Controller Module (CSC)
			●			TLN3011A**	*Privacy Plus* Type II Central Site Controller Module
			●			TLN3012A**	*Privacy Plus* Type II /Transmitter Site Controller Module (TSC)
			●	●	●	TRN8661A	Receiver Interface Board (RIB)
			●	●	●	TRN8662A	Inbound Recovery Board (IRB)
			●	●	●	TRN8663A	Transmitter Interface Board (TIB)

MAEPS-43302-D

Options Chart for T5004A and T5076A

Option	Add	Description
D162	Time–Out Parameters	Examine/Modify System Time–Out Parameters
D179	TLN3001A, TLN3000A, TRN8661A, TRN8662A, TRN8663A	Spare Board Set
D189	TVN6025A	Status/Message Option
D277	TRN8668A ac Line Conditioner	Provides ac Line Regulation
D311	TLN2997A CSC	Spare Central Site Controller
D329	Negative Subscriber List	Prevents Fleet Access
D391	One TRN8661A RIB Module One TRN8663A TIB Module	Adds 7 Channels of Control Capability
D392	Two TRN8661A RIB Modules Two TRN8663A TIB Modules	Adds 13 Channels of Control Capability
TEN6081		Installation and Service Kit
TPN6114		+5 Vdc Power Supply
TPN6115		±12 Vdc Power Supply
D411	Fleet Access Control	Prevents Fleet Access
D412	Subscriber Access Control *Privacy Plus*	Prevents Individual Access
D413	Subscriber Access Control *Smartnet*	Prevents Individual Access

Options Chart for T5152A

Option	Add	Description
D391	One TRN8661A RIB Module One TRN8663A TIB Module	Adds 7 Channels of Control Capability
D392	Two TRN8661A RIB Modules Two TRN8663A TIB Modules	Adds 13 Channels of Control Capabiity
D162	Time–Out Parameters	Examine/Modify System Time–Out Parameters
D412	Subscriber Access Control *Privacy Plus*	Prevents Individual Access
D435	Priority SAL	Allows Individual Priority Level Assignment
D179	TLN3001A, TLN3012A, TRN8661A, TRN8663A, TRN8662A, TLN3011A	Spare Board Set

Options Chart for T5184

Option	Add	Description
D179	TLN3033A, TLN3035A, TLN3036A, TRN8661A, TRN8662B, TRN8663A, TVN6047A	Spare Board Set
D277	TRN8668A ac Line Conditioner	Provides ac Line Regulation
D389	TRN7056A	Redundant Controller Interface
D391	One TRN8661A RIB Module One TRN8663A TIB MOdule	Adds 7 Channels of Control Capability
D392	Two TRN8661A RIB Modules Two TRN8663A TIB Modules	Adds 14 Channels of Control Capability

DESCRIPTION, INSTALLATION & MAINTENANCE

DESCRIPTION 68P81040E02
INSTALLATION 68P81066E58
SAFE HANDLING OF CMOS INTEGRATED CIRCUIT DEVICES 68P81106E84
MAINTENANCE 68P81040E04

CARD CAGE CHASSIS

21-CHANNEL CARD CAGE CHASSIS 68P81046E94

MODULES

SITE CONTROLLER MODULES 68P81066E59
SITE CONTROLLER BOARD 68P81066E61
INBOUND RECOVER BOARD 68P81040E09
RECEIVER INTERFACE BOARD 68P81040E11
TRANSMITTER INTERFACE BOARD 68P81040E12
ASYNCHRONOUS COMMUNICATIONS BOARD 68P81125E55
SITE INTERFACE BOARD 68P81125E56
SITE AUDIO BOARD 68P81125E57

POWER SUPPLIES

POWER SUPPLIES 68P81040E13

DESCRIPTION

1. INTRODUCTION

1.1 The information provided in this section describes basic system functions of the equipment used in a Motorola Trunked Radio System. It is meant only to provide an overall system description. The description is presented so that the Central Controller portion of the system described in this manual is more completely understood.

1.2 Trunking is the automatic sharing of a large group of communications channels. Its most important asset is the ability to dramatically reduce channel waiting times, as compared with those of conventional systems. Trunking is efficiently achieved by distributing the message traffic equally among the available channels.

1.3 The Motorola Trunked Radio System operates in the 800 MHz frequency spectrum. The system employs the following equipment:

- central controller
- base repeater stations (as required)
- RF control stations (as required)
- mobile radio units (as required)

1.4 Figure 1 illustrates a basic five-channel (up to twenty channels available) system configuration, centrally located in the area requiring radio coverage. For simplification, only three of many possible user fleets are shown. Each fleet employs an rf control station (dispatcher) and one or more groups of radio-equipped vehicles.

1.5 The central controller is the heart of the Motorola Trunked Radio System. The central controller is structured around three microprocessor subsystems:

- Central Site Controller (CSC) module,
- Transmitter Site Controller (TSC) module,
- Receiver Site Controller (RSC) module,

and three interface subsystems:

- Receiver Interface Board (RIB) module,
- Inbound Recovery Board (IRB) module,
- Transmitter Interface Board (TIB) module.

1.6 All modules are housed in a single card cage. The subsystems use the Motorola M6809 Series microprocessor family.

1.7 The microprocessor-based central controller directs the operation of the Motorola Trunked Radio System and is responsible for managing the flow of communications among the Motorola Trunked Radio System users. This includes processing of call requests, gathering of statistical data, and providing status and alarm reports.

1.8 The central controller is intended to:

- recover and decode inbound signaling service requests

- monitor voice channel activity

- select and assign vacant channels as required by service requests

- generate and encode outbound signaling grants for such purposes as directing system users to specific channels

- generate the subaudible digital information which is superimposed on all voice communications to unmute the audio circuits in those receivers authorized to monitor the communications

- monitor and control each call sequence

- control the base repeater station

- identify the base repeater station in accordance with FCC regulations; this is achieved by automatically generating and transmitting the system call sign in the appropriate format and at the required intervals.

- monitor and report alarm conditions to direct attention to such abnormal conditions as power failure, low rf power on a channel, unidentified carrier on a channel

- provide a system manager interface by means of an optional keyboard terminal

1.9. The Motorola Trunked Radio System provides a variety of features, many of which are not available in conventional systems. These features can be broken down into the following major categories:

- system manager capabilities
- system user call capabilities
- system reliability capabilities
- system access features
- system expansion features

2. SYSTEM MANAGER CAPABILITIES

2.1 CHANNEL CAPABILITY

FCC Docket No. 18262 stipulates that users or system operators needing six or more channels in the 800 MHz spectrum are required to operate trunked systems. Moreover, trunked systems from a minimum of five channels to a maximum of twenty channels are authorized. The basic Motorola Trunked Radio System consists of five channels of hardware, and can be expanded to twenty channels with factory installed options, or field installed options.

2.2 CO-LOCATED BASE END EQUIPMENT

A typical five-channel Motorola Trunked Radio System is a single site system, thus requiring that the five repeater stations and the central controller be located at one site. The central controller can be located a maximum distance of 100 cable feet from the base repeaters. With such an arrangement, all servicing and operating functions can be carried out at the site.

2.3 SYSTEM CALL CAPABILITY (OPTIONAL)

The system call option allows the manager to broadcast a message to each unit in the system, interrupting any calls in progress. Thus, by making a single system-wide call, the system manager can relay an urgent or important message to all users at the same time. System call

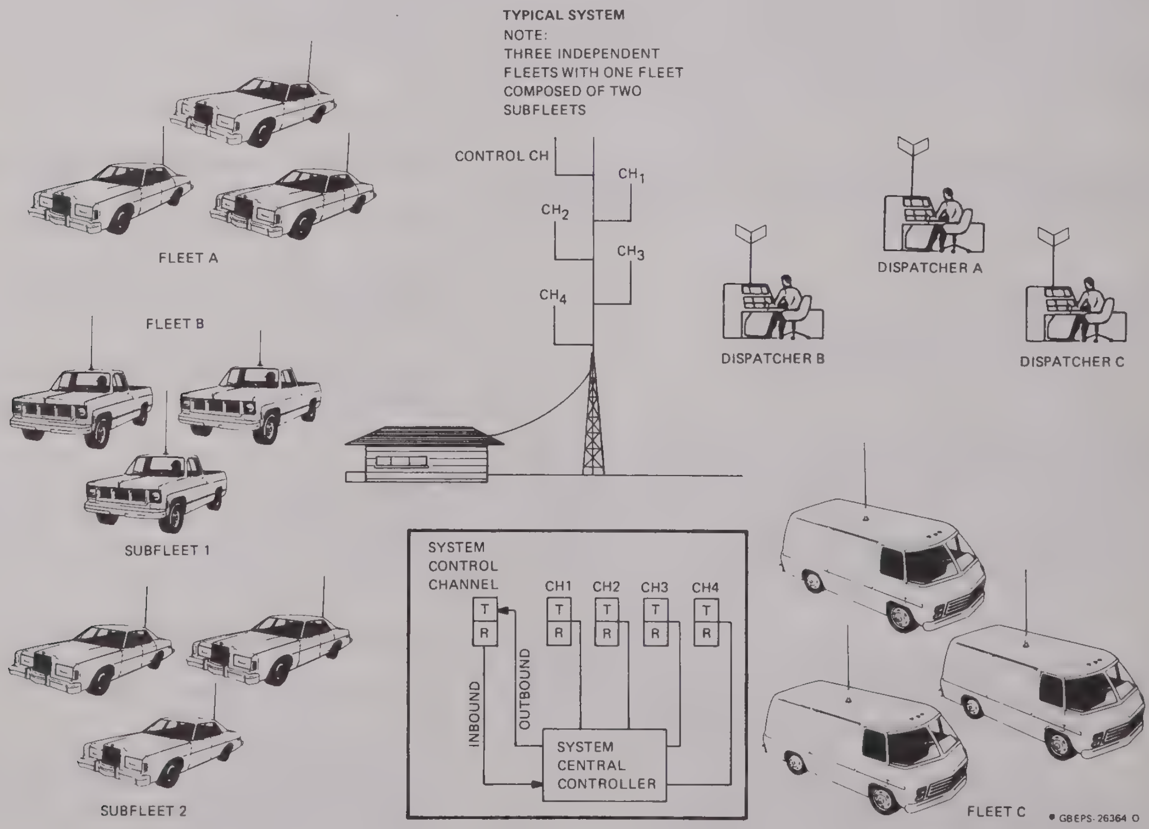

TYPICAL SYSTEM
NOTE:
THREE INDEPENDENT FLEETS WITH ONE FLEET COMPOSED OF TWO SUBFLEETS
CONTROL CH
CH$_1$
CH$_2$
CH$_3$
CH$_4$
FLEET A
FLEET B
SUBFLEET 1
SUBFLEET 2
DISPATCHER A
DISPATCHER B
DISPATCHER C
SYSTEM CONTROL CHANNEL
CH1
CH2
CH3
CH4
T
R
INBOUND
OUTBOUND
SYSTEM CENTRAL CONTROLLER
FLEET C
GBEPS-26364 O

Figure 1. Typical Five-Channel System

capability can also be given to selected rf control stations. This, however, is accomplished only at the discretion of the system manager.

2.4 SYSTEM CONTROL TERMINAL INTERFACE

The central controller provides an RS-232-C interface that allows the connection of an optional keyboard terminal to the system. The terminal provides the system manager with a higher level of system control. The terminal can be used to:

- provide reports on equipment status and alarms
- selectively enable or disable individual channels
- adjust system time-out parameters
- report channel activity status
- enter time and date information for error reporting

A Motorola Area System Engineer (ASE) must be consulted for selection of the proper type of terminal.

3. SYSTEM USER CALL CAPABILITIES

3.1 SUBFLEET CALL

The subfleet call is the basic element that is served by the Trunked Radio System. Also, the subfleet call is the standard call capability. A subfleet call allows all member subfleet radio units to monitor and initiate transmissions within that subfleet only. This provides the effect of a private channel on the subfleet level.

3.2 FLEET CALL (OPTIONAL)

3.2.1 This option allows the user of a Motorola Trunked Radio System to simultaneously initiate communications with all members of the fleet, without regard to subfleet boundaries. The central controller monitors any subfleet call made within the fleet on a FIFO (first-in-first-out) basis. Fleet privacy is assured since no two fleets would ever be assigned the same voice channel at the same time. This makes it impossible for any member radio unit of one fleet to interfere with members of another fleet. This eliminates the need to monitor other users before starting transmissions.

3.2.2 An optional selector switch allows mobile radio units of the same fleet to selectively move between subfleets within the fleet. Moreover, dispatchers (rf control stations) and selected mobile radios can be given both fleet call and subfleet call capabilities by means of a single selector switch. Fleet call, in a subdivided fleet, allows the dispatcher or selected mobile operator to transmit a message to all member radio units in his fleet, without regard to subfleet boundaries.

3.2.3 The subfleet call and fleet call selections are made via a single selector switch. The system-wide call is made via a separate, momentary-action, key-lock switch. The basic rf control station can be programmed either to operate within a specified subfleet or be given a fleet call capability. With this latter capability, its transmissions would be heard in all subfleets, and its receiver would monitor activity in all subfleets, on a FIFO (First-In-First-Out) basis.

3.2.4 An rf control station, equipped for multiple subfleet operation, receives only one subfleet at a time. Consequently, if the dispatcher sets the selector switch to one subfleet, he will not receive calls originating in a different subfleet. The same holds true for fleet call operations. If there is simultaneous operation in different subfleets, an rf control station placed in the fleet-call mode receives only one subfleet, since the rf control station receives the subfleets on a FIFO basis. Multiple rf control stations allow the dispatcher to monitor calls in more than one subfleet simultaneously.

3.3 SYSTEM-WIDE CALL (OPTIONAL)

This option, which is available only for the rf control station, is intended to permit the system manager to make one-way announcements to all members of the system. Any responses made to a system-wide call are made at the fleet or subfleet call level.

3.4 STATUS-MESSAGE CALLS (OPTIONAL)

This option in *Privacy Plus* central controllers allows radios to provide 8 status and 8 message call types to be logged on a system logger, giving the system manager information about the status of the subscriber units in the field.

4. SYSTEM RELIABILITY CAPABILITIES

4.1 MULTIPLE CHANNELS

4.1.1 The multiple channel aspect of the Motorola Trunked Radio System provides a high degree of system reliability. Motorola Trunked Radio System channels are assigned by the central controller as needed. No user is dependent on any given channel for his communications. A failure of any one channel, in a Motorola Trunked Radio System, is probably not usually apparent to the users.

4.1.2 If a channel fails, the central controller is programmed to assign only the working channels. Only during busiest use periods would the users of the Motorola Trunked Radio System notice heavier-than-normal channel holding times and longer-than-normal user access times caused by the loss of a channel.

4.2 BACK-UP CONTROL CHANNELS

The failure of an individual channel would not (in most cases) lead to a degradation of system performance. If the control channel fails, however, the whole system could go off the air. To prevent this, the system controller can rotate the control channel to one of the first four channels. Under such conditions, the mobile units recognize the new control channel and system operation proceeds without interruption.

4.3 RECEIVER INTERFERENCE

A Trunked Radio System base repeater may be jammed by the receipt of an unauthorized signal. The central controller is programmed to turn off the repeater whenever it detects a carrier on a channel that has not been assigned to members of the system. The repeater is reassigned only when the unwanted carrier is removed.

4.4 TRANSMITTER FAILURE

The central controller is programmed to detect any loss or reduction in the output power of any of the repeater transmitters. When the transmitter output power falls below a certain level, the channel is automatically taken out of service.

4.5 SYSTEM SELF-DIAGNOSTICS

The system self-diagnostics comprise central controller integrity, repeater receiver interface checks, and repeater transmitter interface checks. The detection of a fault can trigger visual and/or audible alarms at the controller site. Relays are used for implementing these alarm functions.

4.6 FAILSOFT

4.6.1 A failsoft feature is incorporated into the system to insure continued communications whenever the system central controller develops a fault. When the central controller becomes inoperative, the mobile units automatically revert to their preassigned failsoft channels (system voice channels) and are capable of conventional repeater operation on these channels. Once in the failsoft mode, however, the system loses most of its fleet and subfleet privacy, but this privacy is resumed as soon as normal system operation is restored.

4.6.2 A subaudible data handshake is activated on each voice channel whenever the repeaters goes into failsoft mode. This insures that the mobile units do not operate in the failsoft mode simply because they went out of range of the central. Thus, the mobile units remain operative as long as they receive the subaudible data.

4.6.3 Since failsoft channel assignments are a function of the mobile unit code plug, they must be specified at the time of code plug programming. These assignments are made such that all the system mobile units are evenly distributed over the system voice channels. Members of the same fleet or subfleet should be assigned to the same channel. Mobile units can be denied failsoft operation.

5. SYSTEM ACCESS FEATURES

5.1 TALK PROHIBIT TONES

There are times when all the channels in the Trunked Radio System are busy. Since it is not possible to monitor other users on a trunked system, mobile operators are provided with telephone-type busy or talk-prohibit tones. Any user depressing his PTT pushbutton while the system channels are busy receives a talk-prohibit tone. This tone is also provided whenever the mobile operator cannot access the system because of the following reasons:

- the mobile unit is out of range
- the system is out of service

5.2 BUSY TONE

This feature provides a mobile operator with a BUSY tone which is activated only when the PTT pushbutton is depressed at a time when all channels are busy. A mobile operator who receives a talk prohibit tone can assume that his unit failed to gain access to the system.

5.3 BUSY QUEUE/CALL BACK

Users requesting system access at a time when all voice channels are in use are put in a waiting queue and are served on a FIFO basis. When a channel becomes free, the central controller sends a call back tone to the first mobile unit in the waiting queue. The call back consists of a short series of beeping tones which can be heard by the mobile operator. This feature permits the operator who receives a busy indication to set down his microphone and wait for the call back signal rather than keep on depressing his PTT pushbutton in an attempt to access a system channel. These features operate only when the mobile unit is within range.

5.4 TALK-PERMIT TONE (OPTIONAL)

This feature provides a mobile operator with a brief series of tones whenever he keys up a voice channel. The talk-permit tones, which are identical to the call back tones, provide the operator with an indication that he has keyed up on a voice channel. Since this feature is a code-plug-implementable option, it can be provided on a select number of mobile units as desired.

5.5 AUTOMATIC RETRY

A channel request is initiated by depressing the PTT pushbutton and causing the transmitter to send a burst of data to the central controller via the control channel. Since a single burst of data may not get through because of adverse signaling conditions or interference, the radio unit is designed to keep on sending channel request — until a request acknowledgement is received from the central controller or until four seconds have elasped. These attempts continue even if the operator releases his PTT switch. Thus, the operator is not required to continually depress his PTT pushbutton in an attempt to gain access to the system.

5.6 RECENT USER PRIORITY

This feature provides users who have been assigned voice channels with priority over other system users, thus insuring that a fleet engaged in a message transmission gets system access priority even if there is a significant delay between transmissions. This reduces the possibility of a channel not becoming available during an exchange of transmissions if a mobile operator is slow in responding.

5.7 MISDIRECTED MOBILE PROTECTION

To insure that no mobile unit from one fleet is accidentally assigned to a voice channel used by a different fleet, a subaudible data handshake is implemented in the system. Once a fleet is assigned to a voice channel, the repeater of the assigned channel keeps on sending an outbound stream of subaudible data containing the unique fleet or subfleet ID of the units using the channel. Should a unit from a different fleet or subfleet be accidentally assigned to the same channel, the unit automatically reverts to the control channel since it does not have the proper ID. The audio of the erring mobile unit is muted and the transmitter disabled for the fraction of a second that it actually spent on the wrong channel and thus could neither monitor nor key up on the wrong channel.

5.8 CONTINUOUS ASSIGNMENT UPDATING

Once a voice channel is assigned to a fleet or subfleet, the control channel keeps on transmitting the channel assignment for as long as that fleet is using the channel. This insures that a mobile just coming into service is directed to the appropriate channel to join the rest of his fleet. The assignment updating information is sent serially, and the total time that is required by the control channel to run through 19 assignments on a 20-channel system is approximately 500 milliseconds.

5.9 SYSTEM EXPANSION FEATURES

The Motorola Trunked Radio System is structured such that it allows the addition of mobile units without affecting the operation and privacy of mobile units currently using the system. Mobile units can be added to an existing user fleet or new users can be added without the need for any system changes — within the capacity limitations of the system.

6. SIGNALING

6.1 Effective system operation is achieved by binding the individual system blocks into a highly efficient coordinated entity by means of the data communications network. The majority of the data communications operations occurs over the system control channel. For example, requests for service are transferred from the system users to the central controller over this channel. Similarly, the control channel is used by the central controller to transfer channel assignment data or other control commands to the users.

6.2 All communications over the control channel employ data words which are approximately 23 milliseconds long. These data words contain the information capacity required to address particular mobile units or groups and to specify the action to be taken. The information bits comprising these words are appropriately assembled into a coded format that has sufficient error-correction and detection capabilities to insure that highly reliable data communications is maintained in a two-way mobile radio environment. The encoded binary data is passed to the transmitter at a 3600 baud rate where it is filtered and impressed on the carrier by using direct baseband frequency modulation.

7. EQUIPMENT

7.1 The system central controller is designed for standard 19-inch rack mounting and requires 12-1/4 inches of vertical rack space. Its power supply requires 10-1/2 inches of vertical space.

WARNING

Open rack mounting of the equipment is not recommended because of exposed 120 volt ac wiring to the power supplies.

7.2 The central controller logic hardware is housed in a single card cage which can accommodate as many as 13 printed circuit board modules (Figure 2). A typical five-channel central controller (Figure 3) requires one each of the following circuit board modules:

- Central Site Controller (CSC) module
- Transmitter Site Controller (TSC) module
- Receiver Site Controller (RSC) module
- Receiver Interface Board (RIB) module
- Inbound Recovery Board (IRB) module
- Transmitter Interface Board (TIB) module

7.3 Two additional RIB modules and two additional TIB modules are added to extend system capability to 20 channels (Figure 4). The three vacant slots on the left are intended for modules to provide the system with additional optional capabilities.

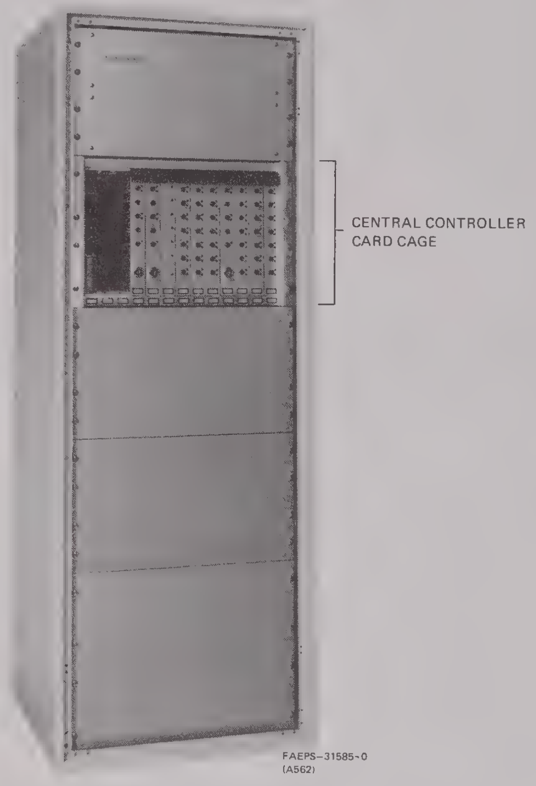


Figure 2. Front View of Central Controller

7.4 The central controller can be functionally divided into three major areas; the central site controller, the transmitter site controller, and the receiver site controller. Each site controller uses a microprocessor to perform the necessary control functions associated with each site. A simplified block diagram of the system central controller is shown in Figure 5.

8. MODULE SWITCHES AND INDICATORS

8.1 GENERAL

8.1.1 The front panel of each of the modules (Figure 6) is equipped with a number of switches and LED indicators. The switches are used for system control and testing. Each site controller board (CSC, RSC, TSC) is provided with a key-lock switch that locks out all the functions associated with the particular site, thus eliminating the possibility of accidental change in a system caused by the inadvertent activation of a switch.

8.1.2 The following paragraphs discuss the function of the switches, and corresponding LED indicators, for each module.

8.2 CENTRAL SITE CONTROLLER MODULE

- **DISABLE** pushbutton — No function in standard application.

- **RUN** LED — Lit when module functioning normally. **DISABLE** LED — Lit when module disabled.

- **RESET** Pushbutton — When depressed, resets system hardware, re-initialized system variables, and performs system software diagnostic test.

- **TEST** Pushbutton — When depressed, activates system software diagnostic test.

- **ACTIVE** LED — Lit while system software diagnostic test running.

Flashes when **FAILURE** LED lights. Flashing indicates module has output information, which requires system manager terminal be connected to backplane interconnect board (RSC Terminal J2) to release information.

- **FAILURE** LED — Lit when system software diagnostic test fails, the normal system operation disabled. Disable function may be overridden by depressing RSC **ALARM CUTOFF** pushbutton does not extinguish **FAILURE** LED).

- **INDICATOR TEST** Pushbutton — When depressed, lights all LEDs on all modules in card cage, to allow visual LED check.

- **ALARM CUTOFF** Pushbutton — When depressed, disable all CSC module alarms. Provides override of CSC module failure (**FAILURE** LED lit), LED indicator lit when **ALARM CUTOFF** PUSHBUTTON depressed.

- Keylock Service Enable Switch — Used to activate **RESET** or **TEST** pushbuttons. Proper activation requires the following procedure:

Step 1. Turn RSC key switch to **SERVICE** position;

Step 2. Depress and release appropriate pushbutton; and

Step 3. Turn RSC key switch to **RUN** position.

CAUTION
DO NOT turn key switch with either pushbutton held depressed — can cause system hardware lock up. (Release of inadvertent lock up accomplished by re-use of proper activation procedure.).

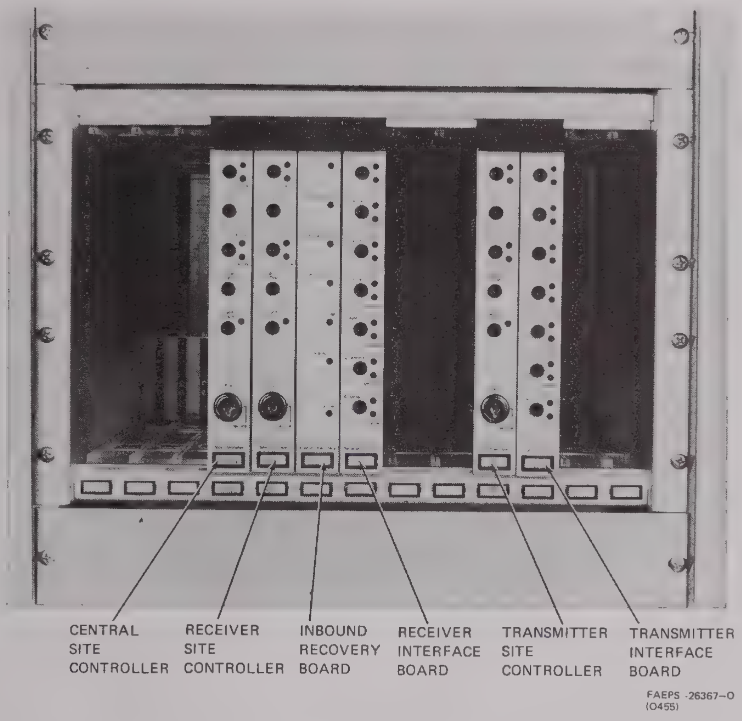

CENTRAL SITE CONTROLLER
RECEIVER SITE CONTROLLER
INBOUND RECOVERY BOARD
RECEIVER INTERFACE BOARD
TRANSMITTER SITE CONTROLLER
TRANSMITTER INTERFACE BOARD
FAEPS -26367-O (O455)

Figure 3. 5-Channel Central Controller Card Cage

8.3 RECEIVER SITE CONTROLLER MODULE

- **DISABLE** Pushbutton — No function in standard application.

- **RUN** LED — Lit when module functioning formally. **DISABLE** LED — Lit when module disabled.

- **RESET** Pushbutton — When depressed, resets RSC hardware and performs RSC software diagnostic test. The RSC software diagnostic test includes:

a) A test of each RAM integrated circuit;

b) A checksum test of each EPROM integrated circuit;

c) An IRB check; and

d) A RIB check — tone detectors.

- **TEST** Pushbutton — No function is standard application.

- **ACTIVE** LED — Lit while RSC software diagnostic test running. Flashes when **FAILURE** LED lights. Flashing indicates module has output information, which requires system manager terminal be connected to backplane interconnect board (RSC Terminal J9) to release information.

- **FAILURE** LED — Lit when RSC software diagnostic test fails, and normal system operation disabled. Disable function may be overridden by depressing RSC **ALARM CUTOFF** pushbutton (does not extinguish **FAILURE** LED).

- **INDICATOR TEST** Pushbutton — When depressed, lights all LEDs on all modules in card cage, to allow visual LED check.

- **ALARM CUTOFF** Pushbutton — When depressed, disables all RSC module alarms. Provides override of RSC module failure (**FAILURE** LED lit). LED indicator lit when **ALARM CUTOFF** pushbutton depressed.

- Keylock Service Enable Switch — Used to activate **RESET** or **TEST** pushbuttons. Proper activation requires the following procedure:

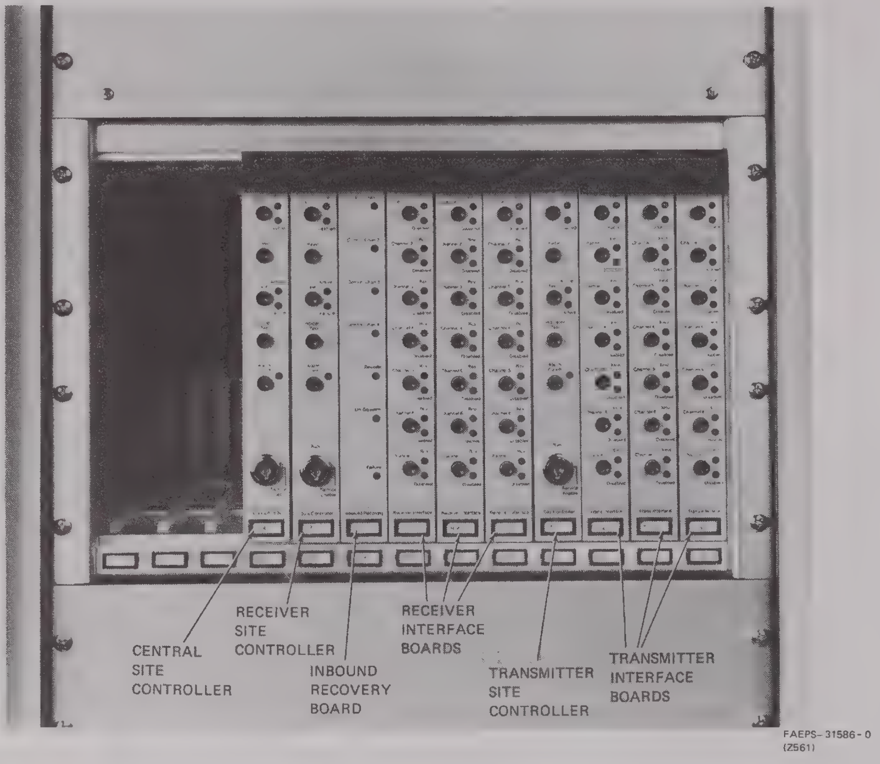

RECEIVER
SITE
CONTROLLER
CENTRAL
SITE
CONTROLLER
INBOUND
RECOVERY
BOARD
RECEIVER
INTERFACE
BOARDS
TRANSMITTER
SITE
CONTROLLER
TRANSMITTER
INTERFACE
BOARDS
FAEPS-31586-0
(Z561)

Figure 4. 20-Channel Central Controller Card Cage

Step 1. Turn RSC key switch to **SERVICE** position;

Step 2. Depress and release appropriate pushbutton;

Step 3. Turn RSC key switch to **RUN** position.

CAUTION

DO NOT turn key switch with either pushbutton held depressed —- can cause system hardware lockup. (Release of anadvertent lockup accomplished by re-use of proper activation procedure.

8.4 TRANSMITTER SITE CONTROLLER MODULE

- **DISABLE** Pushbutton — No function in standard application.
- **RUN** LED — Lit when module functioning normally.
- **DISABLE** LED — Lit when module disabled.
- **RESET** Pushbutton — When depressed, resets TSC hardware and performs TSC software diagnostic test. The TSC software diagnostic test includes:

a) A test of each RAM integrated circuit;

b) A check sum test of each EPROM integrated circuit; and

c) A TIB Check—keys channel and checks transmitter status.

- **TEST** Pushbutton — No function in standard application.
- **ACTIVE** LED — Lit while TSC software diagnostic test running.

Flashes when **FAILURE** LED lights. Flashing indicates module has output information, which requires system manager terminal be connected to backplane interconnect board (TSC Terminal J7) to release information.

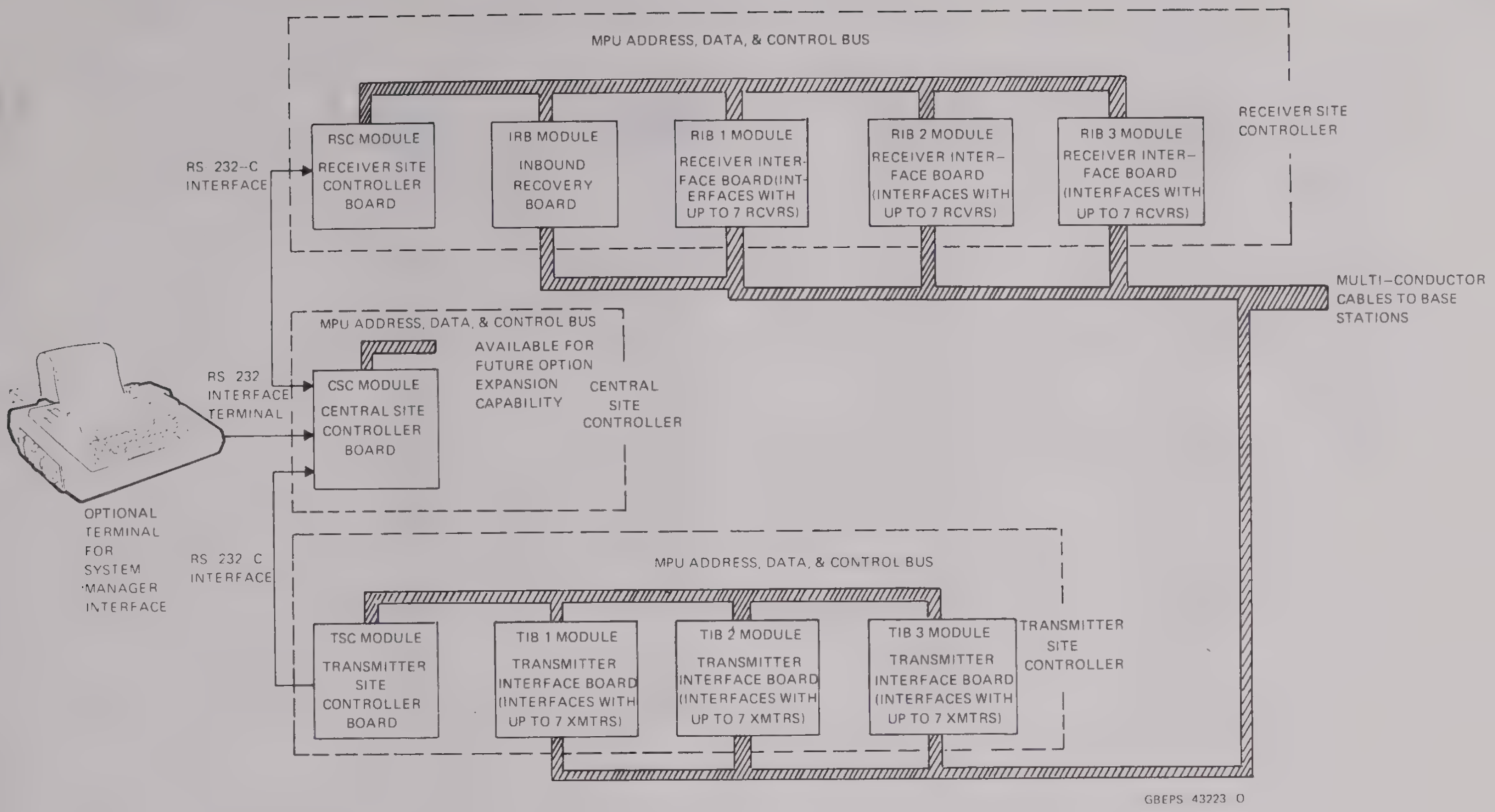

MPU ADDRESS, DATA, & CONTROL BUS
RECEIVER SITE CONTROLLER
RS 232-C INTERFACE
RSC MODULE
RECEIVER SITE CONTROLLER BOARD
IRB MODULE
INBOUND RECOVERY BOARD
RIB 1 MODULE
RECEIVER INTERFACE BOARD(INTERFACES WITH UP TO 7 RCVRS)
RIB 2 MODULE
RECEIVER INTERFACE BOARD (INTERFACES WITH UP TO 7 RCVRS)
RIB 3 MODULE
RECEIVER INTERFACE BOARD (INTERFACES WITH UP TO 7 RCVRS)
MULTI-CONDUCTOR CABLES TO BASE STATIONS
MPU ADDRESS, DATA, & CONTROL BUS
AVAILABLE FOR FUTURE OPTION EXPANSION CAPABILITY
CENTRAL SITE CONTROLLER
RS 232 INTERFACE TERMINAL
CSC MODULE
CENTRAL SITE CONTROLLER BOARD
OPTIONAL TERMINAL FOR SYSTEM MANAGER INTERFACE
RS 232 C INTERFACE
MPU ADDRESS, DATA, & CONTROL BUS
TSC MODULE
TRANSMITTER SITE CONTROLLER BOARD
TIB 1 MODULE
TRANSMITTER INTERFACE BOARD (INTERFACES WITH UP TO 7 XMTRS)
TIB 2 MODULE
TRANSMITTER INTERFACE BOARD (INTERFACES WITH UP TO 7 XMTRS)
TIB 3 MODULE
TRANSMITTER INTERFACE BOARD (INTERFACES WITH UP TO 7 XMTRS)
TRANSMITTER SITE CONTROLLER
GBEPS 43223 O

Figure 5. System Central Controller Block Diagram

- **FAILURE** LED — Lit when TSC software diagnostic test fails, and normal system operation disabled. Disable function may be overridden by depressing TSC **ALARM CUTOFF** Pushbutton (which does not extinguish **FAILURE** LED).

- **INDICATOR** TEST Pushbutton — When depressed, lights all LEDs on all modules in card cage, to allow visual LED check.

- **ALARM CUTOFF** Pushbutton — When depressed, disable all RSC module alarms. Provides override of RSC module failure (**FAILURE** LED lit). LED indicator lit when **ALARM CUTOFF** pushbutton depressed.

- Keylock Service Enable Switch — Used to activate **RESET** or **TEST** pushbuttons. Proper activation requires the following procedure:

Step 1. Turn RSC key switch to **SERVICE** position;

Step 2. Depress and release appropriate pushbutton; and

Step 3. Turn TSC key switch to **RUN** position.

CAUTION

DO NOT turn key switch with either pushbutton held depressed — can cause system hardware lockup. (Release of inadvertent lockup accomplished by re-use of proper activation procedure.)

8.5 INBOUND RECOVERY BOARD MODULE

- **CONTROL CHAN 1-4** LEDs — Lit (one at a time) to indicate which channel is presently assigned as the control channel.

- **DECODE** LED — Flashes to indicate detection of valid Inbound Signaling Word (ISW).

- **UN-SQUELCH** LED — Lit so long as carrier is detected by IRB module. IRB module squelch circuitry, more sensitive than squelch circuitry of base repeater, determines from dc-coupled receiver discriminator signal if channel is sufficiently quieted for digital data to be decoded.

- **FAILURE** LED — Lit when module fails.

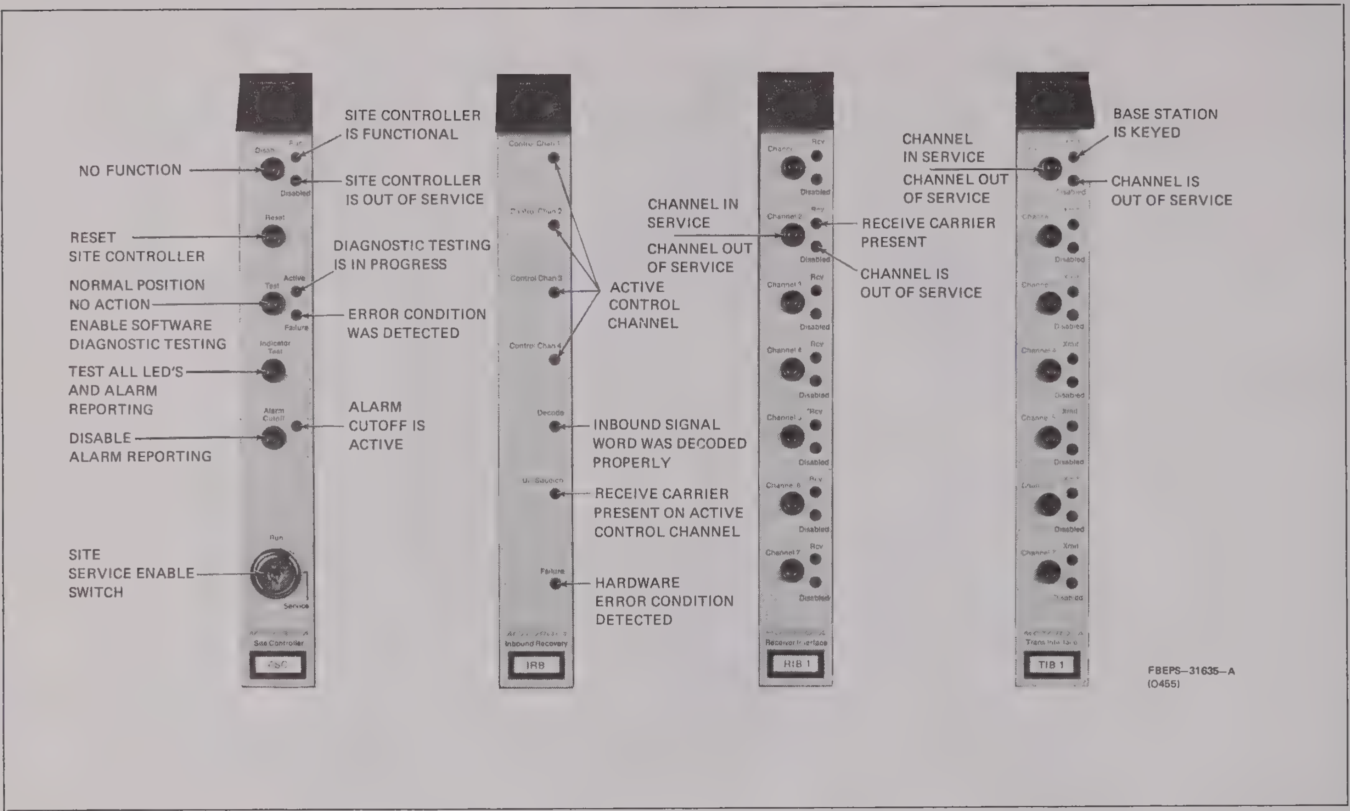

SITE CONTROLLER IS FUNCTIONAL
NO FUNCTION
SITE CONTROLLER IS OUT OF SERVICE
RESET SITE CONTROLLER
DIAGNOSTIC TESTING IS IN PROGRESS
NORMAL POSITION NO ACTION
ENABLE SOFTWARE DIAGNOSTIC TESTING
ERROR CONDITION WAS DETECTED
TEST ALL LED'S AND ALARM REPORTING
ALARM CUTOFF IS ACTIVE
DISABLE ALARM REPORTING
SITE SERVICE ENABLE SWITCH
Site Controller
RSC
ACTIVE CONTROL CHANNEL
INBOUND SIGNAL WORD WAS DECODED PROPERLY
RECEIVE CARRIER PRESENT ON ACTIVE CONTROL CHANNEL
HARDWARE ERROR CONDITION DETECTED
Inbound Recovery
IRB
CHANNEL IN SERVICE
CHANNEL OUT OF SERVICE
RECEIVE CARRIER PRESENT
CHANNEL IS OUT OF SERVICE
Receiver Interface
RIB 1
CHANNEL IN SERVICE
CHANNEL OUT OF SERVICE
BASE STATION IS KEYED
CHANNEL IS OUT OF SERVICE
TIB 1
FBEPS—31635—A
(O455)

Figure 6. Module Controls and Indicators

8.6 RECEIVER INTERFACE BOARD MODULE

- **CHANNEL 1-7** Pushbuttons — Used to manually disable (depressed) or enable (released) channel operation. Must be activated by RSC keylock service enable switch. Proper activation requires the following procedure:

Step 1. Turn RSC key switch to **SERVICE** position;

Step 2. Select (cycle as required) enable or disable position of channel pushbutton(s); and

Step 3. Turn RSC key switch to **RUN** position.

RCV LEDS — Lit when RSTAT signal from corresponding base-repeater(s) is active — up to seven per RIB module.

Active RSTAT signal results when base-repeater squelch circuitry determines, from ac-coupled receiver discriminator signal, if channel is sufficiently quieted for carrier to be present.

DISABLED LEDs — Lit when channel(s):

a) Manually disabled by **CHANNEL 1-7** pushbutton's); or

b) Fail tone detector check via RSC software diagnostic test; or

c) Exceed assigned carrier malfunction time-out period — factory set to 50 consecutive seconds.

NOTE

Carrier malfunction parameter is adjustable (1-255 seconds) through use of optional PARM command by system manager.

8.7 TRANSMITTER INTERFACE BOARD MODULE

- **CHANNEL 1-7** Pushbuttons — Used to manually disable (depressed) or enable (released) channel operation. Must be activate by TSC keylock service enable switch. Proper activation requires the following procedure:

Step 1. Turn TSC key switch to **SERVICE** position;

Step 2. Select (cycle as required) enable or disable position of channel pushbutton(s); and

Step 3. Turn TSC key switch to **RUN position.**

- **XMIT** LEDs — Lit when channel(s) repeater PTT signal active.

- **DISABLED** LEDs — Lit when channel(s):

a) Manually disabled by **CHANNEL 1-7** pushbutton(s); or

b) Fail transmitter status check via TSC software diagnostic test; or

c) Corresponding base-repeater provides a non-active TSTAT signal from its Trunked Control module. Non-active TSTAT signal indicates base-repeater transmitter has low forward rf power or excessive reflected rf power.

MOTOROLA INC.
Communications
Sector

INSTALLATION

1. INSPECTION

Carefully inspect the equipment as soon as possible upon receipt and immediately report any damage to the transportation company.

2. PLANNING THE INSTALLATION

Installation plans should be laid out carefully before actual work is begun. Careful consideration should be given to location of the equipment in relation to the base repeater stations, electrical power outlets, and accessibility of the equipment for servicing. The following points should be used as a guide in the initial setup of the equipment and while planning for future expansion.

- The central controller cabinet should be located in the middle of the base repeater cabinets to minimize cable lengths.
- Consideration should be given in advance to the floor space that is required for adding more base repeater stations to the system.
- Servicing the front and back of the central controller is simplified if its cabinet is located near the end of an aisle.
- The aisle width should provide sufficient clearance to permit installation of a board on the extender board. A clearance of not less than 30 inches is recommended.
- The total (present and future) power requirements should be calculated.
- The central controller equipment is mounted in a standard 60-inch high cabinet.
- Heat is exhausted through the top of the cabinet.
- Cutouts for cable runs are provided on the top of the cabinet.
- A control cable is required for each base repeater station. The cable (whether standard or optional) is terminated in a 15-position connector on one end and spade/lug terminals or a 25-pin D connector on the other. The standard control cable is 25 feet long. Optional cable lengths are 50, 75, and 100 feet.

3. CABINET

The power supply and the central controller equipment are mounted in a 60-inch high cabinet. A solid, level surface should be chosen for the cabinet site.

4. CENTRAL CONTROLLER CIRCUIT BOARD MODULES

4.1 A central controller requires the following plug-in circuit board modules (see Figure 1):

- one Central Site Controller (CSC) module,
- one Transmitter Site Controller (TSC) module,
- three Transmitter Interface Board (TIB) modules,
- three Receiver Interface Board (RIB) modules,
- one Receiver Site Controller (RSC) module,
- one Inbound Recovery Board (IRB) module.

4.2 Each of these modules should be inserted into its designated slot.

5. INTERFACING TO THE BASE REPEATER STATION

5.1 A standard 25-foot control cable kit (TKN8016A for 800 MHz stations and TKN8498A for *MSF5000* stations) is provided with each repeater for interfacing it to the central controller. The following control cables are also available as base station options:

- 50-foot control cable
- 75-foot control cable
- 100-foot control cable

5.2 The distance between the central controller and a base station repeater cannot exceed 100 cable feet.

technical writing services
1301 E. Algonquin Road, Schaumburg, IL 60196

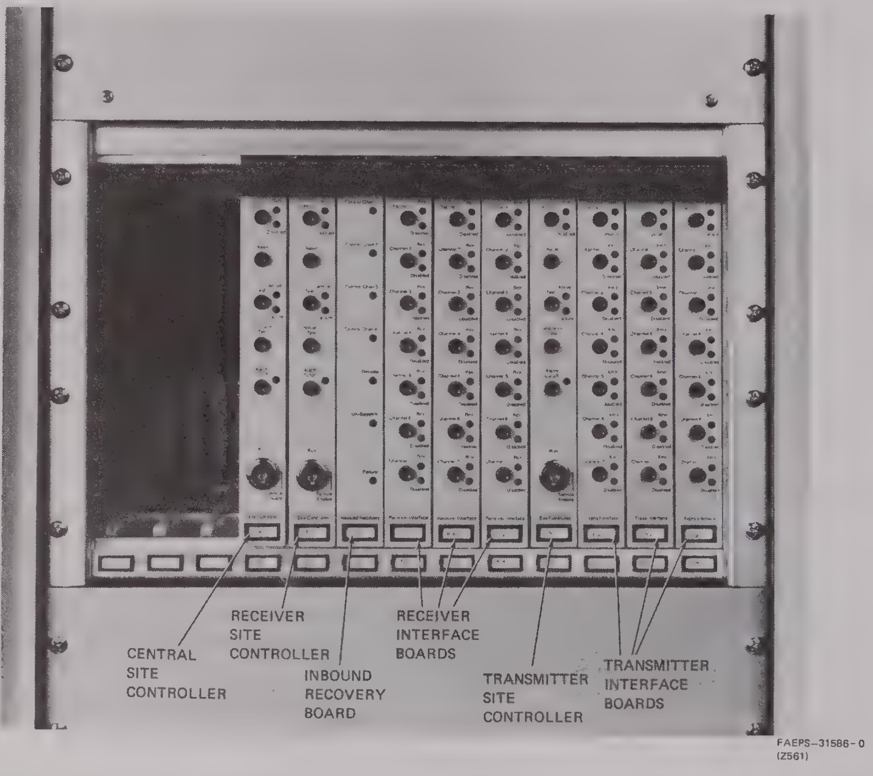


Figure 1. 20-Channel Central Controller Circuit Board Modules

5.3 For 800 MHz base stations the control cable is terminated in a 15-pin connector at one end and spade lugs at the other. A complete set of lugs and sleeving is provided for field termination of the cable for those installations requiring custom cable lengths or cables that are not terminated to facilitate their installation. The installation of the spade lugs is not a recommended field operation since the cable consists of six individually-shielded twisted wire pairs with a thick black wire used in each twisted pair. For the *MSF5000* base stations, the control cable is terminated in a 15-pin connector at one end and a 25-pin D connector at the other.

5.4 Figure 2 provides a rear view of the central controller cabinet. Besides the power supplies, these photographs identify the following connectors:

- 20 base repeater station connectors
- Major and minor alarm screw terminals
- Ten RS-232-C connectors which interface the central controller to optional equipment such as a magnetic tape transport.
- Four RS-232-C connectors for remote site applications
- Three sets of RS-232-C connectors for interfacing each of the three site controllers to an optional terminal for on-site testing and other options.

5.5 The RS-232-C type connectors provide a data terminal interface (electrical and mechanical) for connection to data communication equipment. Connections to data terminal equipment can be made through an industry standard null modem cable.

5.6 The central controller can serve up to twenty base stations. Consequently, an interface control cable is connected between the appropriate base repeater station connector (CH1-CH20) on the central controller backplane and the screw terminal connectors or the 25-pin D connector located in the base repeater stations. The cable end, terminated in a plug, is connected to the appropriate connector on the central controller backplane, whereas the cable end terminated in spade lugs or the 25-pin D connector is connected to the base station. Refer to the four interconnect charts that are part of the 20-Channel Card Cage Chassis instruction section

(68P81046E94) of this manual. Also refer to the section which describes the interface connection in Instruction Manual 68P81038E85 for the 800 MHz Trunked Base Repeater or 68P81064E70 for the *MSF5000* Trunked Base Repeater..

6. ALARM INDICATORS

The central controller backplane is provided (as shown in Figure 2) with four screw terminal connectors which can be used for connecting the system to major and minor alarm indicators, as required by the user. Upon detecting an alarm condition, the central controller de-energizes the appropriate alarm relay (major/minor) to activate the corresponding alarm. Each dry-contact relay has a rating of 100 milliamperes at 28 volts. These specifications should be taken into consideration before connecting any alarm indicators to the central controller. A typical alarm circuit is shown in Figure 3.

7. TERMINAL INTERFACE

The central site controller terminal interface permits connection to an RS-232-C compatible terminal. This option provides the system with the following functions:

- Equipment status and alarm reporting
- Individual channel on/off capability
- Adjustment of the system timing parameters (optional)
- Channel activity status reporting
- Time and data information entry
- Two entry levels of subscriber control (fleet or individual) list to selectively deny system access to those fleets or individuals.

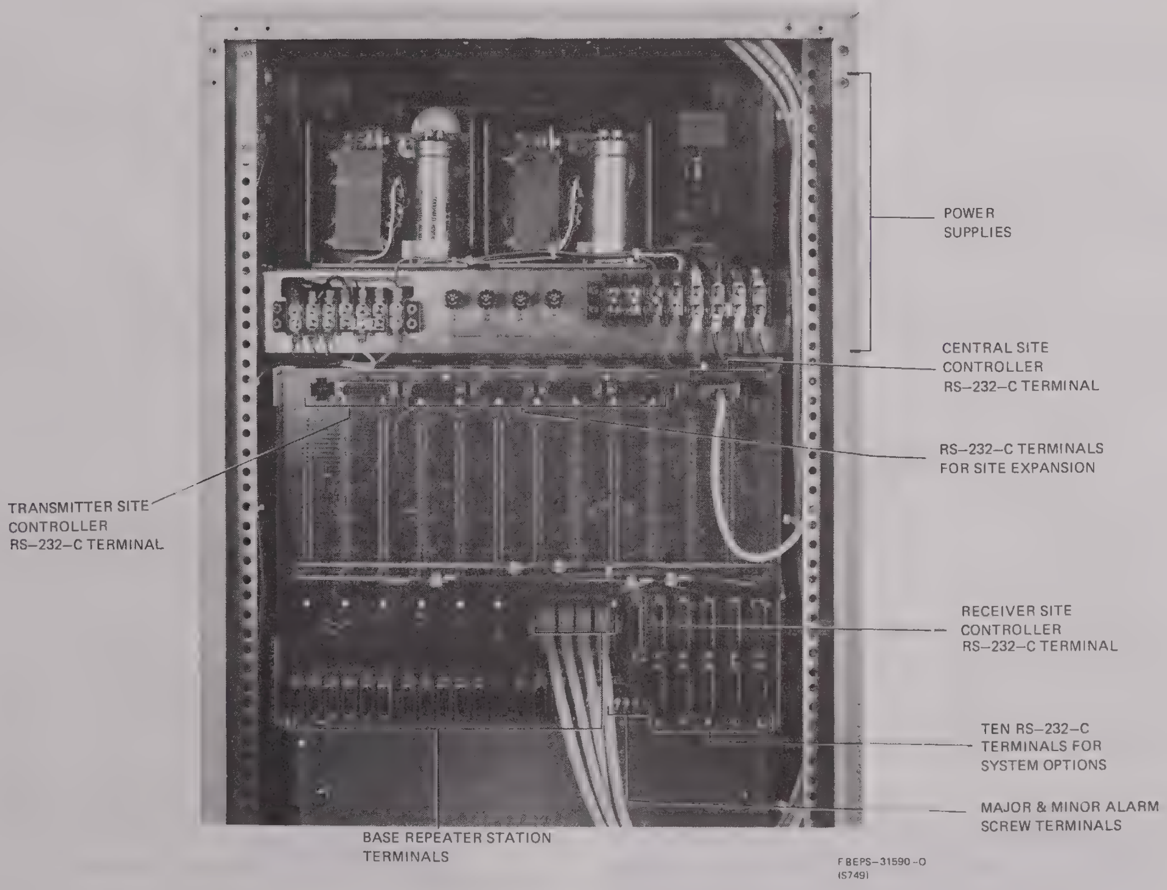
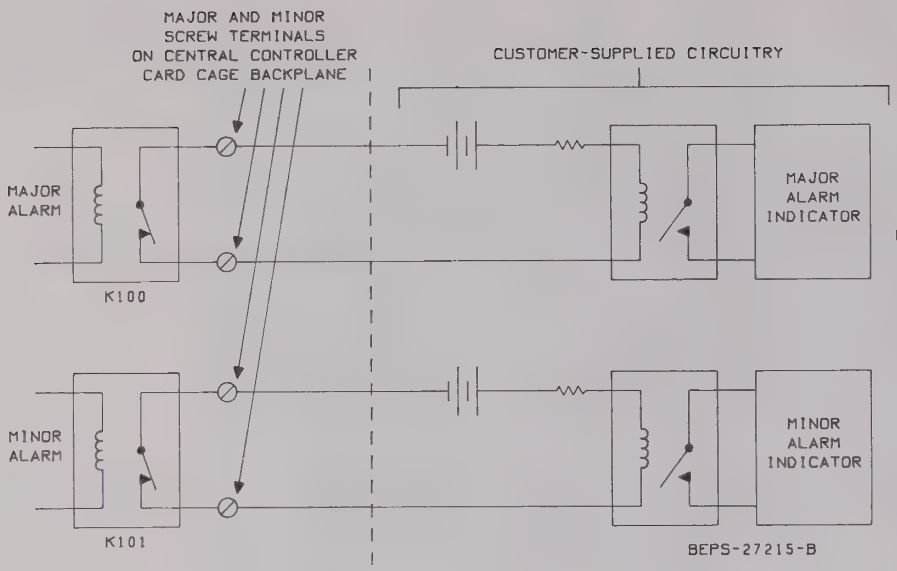

POWER SUPPLIES
CENTRAL SITE CONTROLLER RS–232–C TERMINAL
RS–232–C TERMINALS FOR SITE EXPANSION
TRANSMITTER SITE CONTROLLER RS–232–C TERMINAL
RECEIVER SITE CONTROLLER RS–232–C TERMINAL
TEN RS–232–C TERMINALS FOR SYSTEM OPTIONS
MAJOR & MINOR ALARM SCREW TERMINALS
BASE REPEATER STATION TERMINALS
F BEPS–31590–O (S749)

Figure 2. Rear View of Trunked Radio System Central Controller



NOTES

1. DIAGRAM SHOWS ABSENCE OF ALARM CONDITION (BOTH RELAYS ARE ENERGIZED).
2. CENTRAL CONTROLLER DRY-CONTACT RELAY RATING-28V,100MA.

Figure 3. Typical Major and Minor Alarm Circuitry

- Adjustment of shared service algorithm
- Interconnect activity status

8. INSTALLING THE SYSTEM MANAGER DATA TERMINAL

8.1 When connecting the trunked system central controller directly to an auto-answer dial-up modem, the pins in the CSC terminal connector are used as shown in Table 1.

Table 1. Data Terminal Backplane Connector Pin-Outs

Pin #	Description	Direction of Signal Flow
1	Protective Ground	—
2	Transmit Data	From CSC
3	Receive Data	To CSC
4	Request to Send (RTS)	From CSC
5	CLR to Send (CTS)	To CSC
6	Data Set Ready (DSR)	To CSC
7	Signal Ground	—
8	Data Carrier Detect (DCD)	To CSC
20	Data Terminal Ready (DTR)	From CSC

8.2 Any data terminal such as a CRT or portable printer can be connected directly to the trunked system central controller through a modem eliminator cable (TKN8877A). The Texas Instruments TI765 terminal, however, requires a modified modem eliminator. For further details, refer to System Manager's Operating Manual (68P81065E15 for Type I systems and 68P81071E80 for Type II systems) Hardware Requirements paragraph.

8.3 Install the modem eliminator cable between the CSC terminal connector and the data terminal. Make sure the data terminal is set for the following parameters.

- Rate — same as baud rate selected by jumper JU15
- Parity — mark (1 bit, always zero)
- Character length or number of data bits number — 7 bits
- Number of stop bits — 1 bit
- Duplex — full

9. EPROM AND PAL INSTALLATION IN THE CSC, RSC, AND TSC BOARDS

CAUTION

The software EPROMs may have been shipped in protective integrated circuit tubes. Before applying power to the trunked system central controller, the integrated circuits must be inserted in their respective sockets.

On any board, component side up and the front panel facing left, the integrated circuits are inserted with pin 1 pointed upward and to the left. Refer to Table 2 for installation locations.

Table 2. EPROM and PAL Installation

Socket #	Part Number
TLN2997A CSC Board	
U48	51-90008H50
U47	51-90008H51
U46	51-90008H52
U60	51-90008H53
U59	51-90008H54
U58	51-90008H55
U57	51-90008H56
U30	TRN5726B*
U36	TRN9679A*
TLN3006A *SMARTNET* CSC Board	
U48	51-90008H81
U47	51-90043C45
U46	51-90043C46
U60	51-90043C47
U59	51-90043C48
U58	51-90043C49
U57	51-90043C50
U30	TRN5726B*
U36	TRN9888A*
TLN2999A MCB Board	
U46	51-90008H65
U60	51-90008H66
U59	51-90008H67
U58	51-90008H68
U57	51-90008H69
U30	TRN5726B*
U36	TRN5713A*
TLN3000A TSC Board	
U57	51-90008H20
U30	TRN5726B*
U36	TRN5727A*
TLN3001A RSC Board	
U57	51-90008C96
U30	TRN9306B*
U36	TRN9307A*
TLN3011A Type II CSC Board	
U48	51-90008H81
U47	51-90043C51
U46	51-90043C52
U60	51-90043C53
U59	51-90043C54
U58	51-90043C55
U57	51-90043C56
U30	TRN5726B*
U36	TRN9888A*
TLN3012A Type II TSC Board	
U57	51-90008L07
U30	TRN5726B*
U36	TRN5727A*
TLN3010A Type II MCB Board	
U47	51-90043C63
U46	51-90043C64
U60	51-90043C65
U59	51-90043C66
U58	51-90043C67
U57	51-90043C68
U30	TRN5726B*
U36	TRN9955A*

* May already be inserted.

10. POWER REQUIREMENTS

10.1 GENERAL

The central controller requires an input voltage of 97-145 volts ac at a current of 12 amperes, 50-60 Hz.

NOTE

Option D277 provides a Powermatic, Inc. Model LC-3150H-1K-110 AC Line Regulator.

10.2 POWER SUPPLY ADJUSTMENT

NOTE

All the following voltage measurements must be made at the cable connections on the bus bars located on the central controller backplane.

Step 1. Remove all modules from the central controller card cage.

Step 2. Turn on ac power (use switch S1 on the ac distribution box at the bottom rear of the central controller cabinet).

Step 3. Make the following coarse adjustments:

- adjust power supply #1 (+5 V) for +5.10 ±0.25 V
- adjust power supply #2 (+5 V) for +5.10 ±0.25 V
- adjust power supply #3 (+12 V) for +12.10 ±0.25 V
- adjust power supply #4 (-12 V) for -12.10 ±0.25 V

Step 4. Turn off ac power.

Step 5. Insert all modules into the card cage.

Step 6. Turn on ac power.

Step 7. Allow system to warm up for at least 10 minutes.

Step 8. Make the following fine adjustments:

- adjust power supply #1 (+5 V) for +5.15 ±0.10 V
- adjust power supply #2 (+5 V) for +5.15 ±0.10 V
- adjust power supply #3 (+12 V) for +12.10 ±0.10 V
- adjust power supply #4 (-12 V) for -12.10 ±0.10 V

11. REMOTE SITE CONNECTIONS

Figure 2 shows the four RS-232-C connectors that are intended for site expansion.

12. CHANNELS LOGGING FORM

Table 3 shows a form that can be used by installation personnel for keeping a record of the transmission frequency used with each operating channel.

13. RACKING AND CABLING

Figures 4 and 5, respectively, show typical racking and ac and dc cabling for the Trunked Radio System Central Controller.

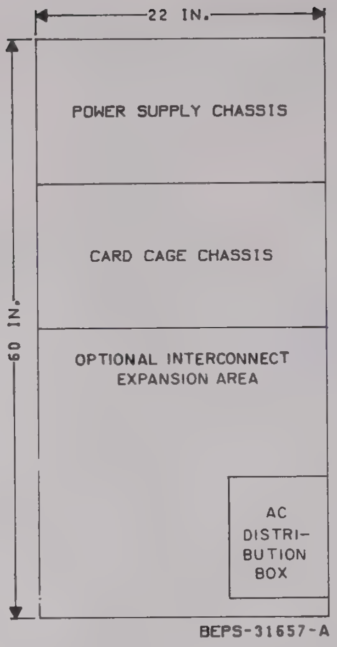
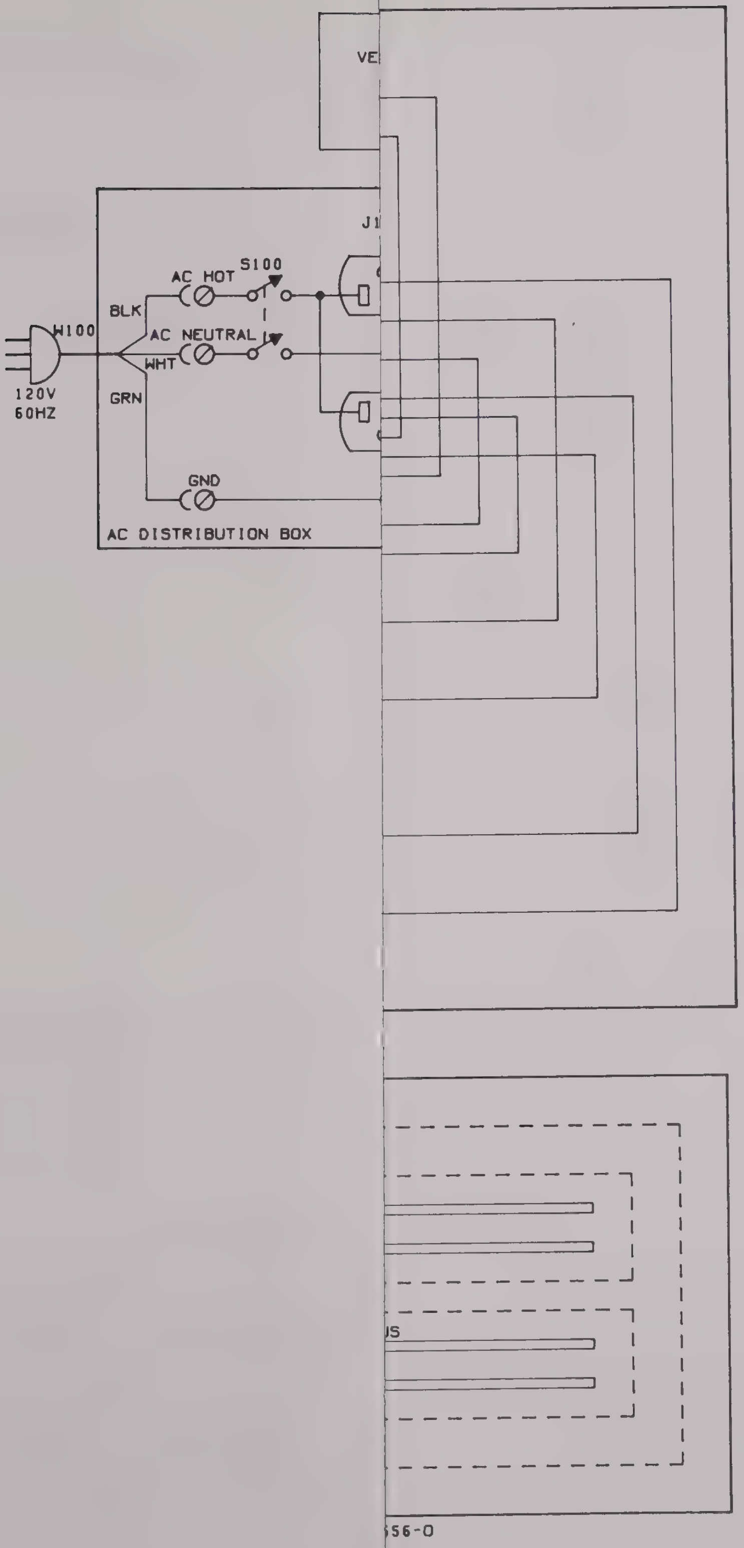

22 IN.
60 IN.
POWER SUPPLY CHASSIS
CARD CAGE CHASSIS
OPTIONAL INTERCONNECT EXPANSION AREA
AC DISTRIBUTION BOX
BEPS-31657-A

Figure 4. Typical Central Controller Racking Diagram (Front View)

Table 3. Channels Logging Form

Central Controller Backplane Connector No.	Trunked Repeater Transmission Frequency (MHz)
CH. 1	
CH. 2	
CH. 3	
CH. 4	
CH. 5	
CH. 6	
CH. 7	
CH. 8	
CH. 9	
CH. 10	
CH. 11	
CH. 12	
CH. 13	
CH. 14	
CH. 15	
CH. 16	
CH. 17	
CH. 18	
CH. 19	
CH. 20	


VE
J1
S100
AC HOT
BLK
W100
AC NEUTRAL
WHT
120V
60HZ
GRN
GND
AC DISTRIBUTION BOX
S
56-0

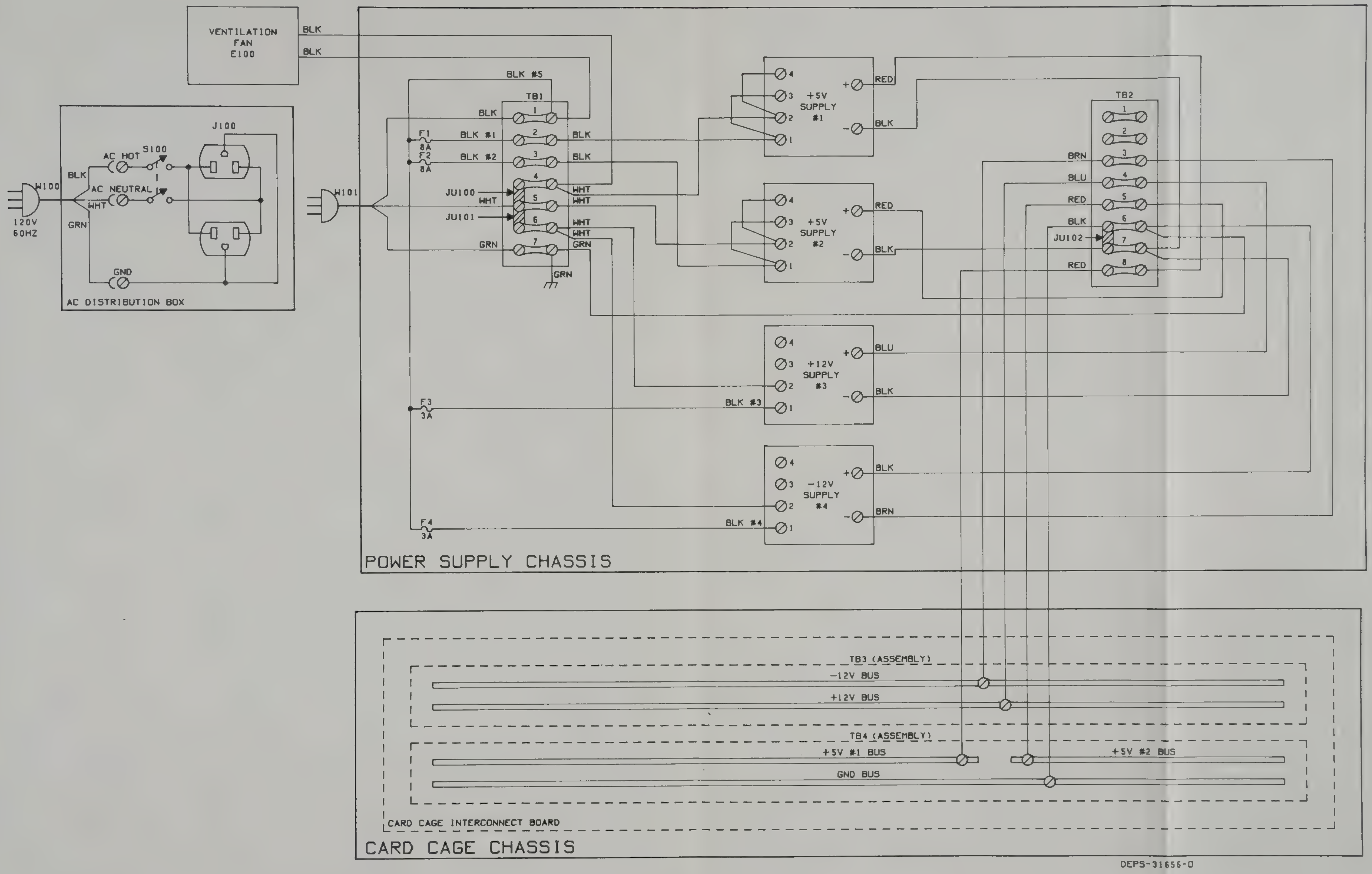

VENTILATION FAN E100
BLK
BLK
AC DISTRIBUTION BOX
J100
S100
AC HOT
AC NEUTRAL
BLK
WHT
GRN
GND
W100
120V 60HZ
W101
POWER SUPPLY CHASSIS
TB1
BLK #5
BLK
BLK #1
BLK #2
F1 8A
F2 8A
JU100
JU101
WHT
GRN
BLK
WHT
WHT
WHT
WHT
GRN
GRN
F3 3A
F4 3A
BLK #3
BLK #4
+5V SUPPLY #1
+5V SUPPLY #2
+12V SUPPLY #3
−12V SUPPLY #4
RED
BLK
RED
BLK
BLU
BLK
BLK
BRN
TB2
BRN
BLU
RED
BLK
JU102
RED
CARD CAGE CHASSIS
CARD CAGE INTERCONNECT BOARD
TB3 (ASSEMBLY)
−12V BUS
+12V BUS
TB4 (ASSEMBLY)
+5V #1 BUS
+5V #2 BUS
GND BUS
DEPS-31656-0

Figure 5. Typical Central Controller AC & DC Cabling Diagram

6629A Housing & Hardware, *SMARTNET* PL-9995-A

EFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		fuse:
, 2	65-82654M01	8 amp; 250 V (slo-blow)
, 4	65-139837	3 amp; 250 V
		mechanical parts
	2-7003	NUT, 8-32 × 5/16 × 1/8"; 5 used
	2-121841	NUT, 6-32 × 5/16 × 7/64"; 4 used
	2-10101A73	NUT, spring: 60 used
	2-84410P05	NUT stamped; 1/4-14"; 20 used
	3-7312	SCREW, machine: 8-32 × 3/4"; 4 used
	3-132258	SCREW, machine: 6-32 × 7/16"; 4 used
	3-124674	SCREW, machine: 8-32 × 1/2"; 8 used
	3-129890	SCREW, lock: 10-32 × 3/8"; 7 used
	3-132285	SCREW, machine: 6-32 × 7/16"; 4 used
	3-135038	SCREW, tapping: 1/4-14 × 3/4"; 20 used
	3-138806	SCREW, lock, 8-32 × 5/16"; 5 used
	3-139564	SCREW, cap: 3/8-24 × 1/2"; 8 used
	3-476083	SCREW, lock: 6-32 × 5/16"; 4 used
	4-7562	WASHER, flat: 0.188 × 0.033"; 2 used
	4-7657	LOCKWASHER #8 external; 4 used
	4-7668	LOCKWASHER, 3/8" external; 8 used
	4-84345A10	WASHER, insulator; 8 used
	5-82670M01	GROMMET; 2 used
	7-82003L01	BRACKET, ground
	7-82557M01	BRACKET, air filter; 10 used
	7-82558M01	BRACKET, mounting; 2 used
	7-82692R01	BRACKET, fan support; 4 used
	9-72973C03	RECEPTACLE, fuse; 4 used
	13-84430D01	GRILLE; 10 used
	14-84562E03	INSULATOR, cover
	15-83445K06	CABINET, 60"
	29-848901	LUG, crimp red; 11 used
	29-824434	LUG, ring
	29-835302	LUG, ring
	30-865903	LINE CORD and PLUG
	30-82687M01	JUMPER, terminal block
	30-82687M02	JUMPER, terminal block; 2 used
	31-82522M01	TERMINAL, block
	31-82596E02	TERMINAL, block; 7 position
	33-83051K01	NAMEPLATE
	35-82668M01	FILTER, air; 10 used
	42-10217A02	STRAP, tie; 6 used
	46-84561E02	STUD, threaded; 4 used
	54-84119B01	LABEL, warn
	64-82627M04	PANEL
	66-84760P01	STRAP, wrist, static
	3-1930	SCREW, machine: 4-40 × 3/8"
	3-7542	SCREW, tapping: 8-15 × 3/8"; 2 used
	5-82275N01	GROMMET, plane
	64-84884M01	PLATE, side
	64-84885M02	PLATE, mounting
	1-80711D86	FAN ASSEMBLY
	3-138133	SCREW, 6-32 × 3/4"; 4 used
	13-83028M01	GRILLE, fan guard
	59-82051A01	MOTOR W/FAN, 120 V ac

te: For optimum performance, diodes, transistors, and integrated circuits must ordered by Motorola part numbers.

MOTOROLA INC.
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SAFE HANDLING OF CMOS INTEGRATED CIRCUIT DEVICES

Many of the integrated circuit devices used in communications equipment are of the CMOS (Complementary Metal Oxide Semiconductor) type. Because of their high open circuit impedance, CMOS ICs are vulnerable to damage from static charges. Care must be taken in handling, shipping, and servicing them and the assemblies in which they are used.

Even though protection devices are provided in CMOS IC inputs, the protection is effective only against overvoltage in the hundreds of volts range such as are encountered in an operating system. In a system, circuit elements distribute static charges and load the CMOS circuits, decreasing the chance of damage. *However, CMOS circuits can be damaged by improper handling of the modules even in a system.*

To avoid damage to circuits, observe the following handling, shipping, and servicing precautions.

1. Prior to and while servicing a circuit module, particularly after moving within the service area, momentarily touch *both* hands to a bare metal earth grounded surface. This will discharge any static charge which may have accumulated on the person doing the servicing.

NOTE
Wearing Conductive Wrist Strap (Motorola No. RSX-4015A) will minimize static buildup during servicing.

WARNING
When wearing Conductive Wrist Strap, be careful near sources of high voltage. The good ground provided by the wrist strap will also increase the danger of lethal shock from accidentially touching high voltage sources.

2. Whenever possible, avoid touching any electrically conductive parts of the circuit module with your hands.

3. Normally, circuit modules can be inserted or removed with power applied to the unit. However, check the INSTALLATION and MAINTENANCE sections of the manual as well as the module schematic diagram to insure there are no objections to this practice.

4. When servicing a circuit module, avoid carpeted areas, dry environments, and certain types of clothing (silk, nylon, etc.) because they contribute to static buildup.

5. All electrically powered test equipment should be grounded. *Apply* the *ground lead* from the test equipment to the circuit module *before* connecting the *test probe*. Similarly, *disconnect* the *test probe prior* to removing the *ground lead.*

6. If a circuit module is removed from the system, it is desirable to lay it on a conductive surface (such as a sheet of aluminum foil) which is connected to ground through 100k of resistance.

WARNING
If the aluminum foil is connected directly to ground, be cautious of possible electrical shock from contacting the foil at the same time as other electrical circuits.

7. When soldering, be sure the soldering iron is grounded.

8. Prior to connecting jumpers, replacing circuit components, or touching CMOS pins (if this becomes necessary in the replacement of an integrated circuit device), be sure to discharge any static buildup as described in procedure 1. Since voltage differences can exist across the human body, it is recommended that only one hand be used if it is necessary to touch pins on the CMOS device and associated board wiring.

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1301 E. Algonquin Road, Schaumburg, Il. 60196

TRUNKED RADIO SYSTEMS
CENTRAL CONTROLLER HARDWARE
PARTS LIST

parts list

THN6377A Cabinet and Hardware Kit (*Privacy Plus*) PL-7282-C

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		fuse:
F1, 2	65-82654M01	8 amp; 250 V
F3, 4	65-139837	3 amp; 250 V
		terminal board:
TB1	31-82596E02	7 screw terminal
TB2	31-82522M01	8 screw terminal
		cable:
W101	30-865903	LINE CORD; includes P100
		mechanical parts
	2-7003	NUT, 8-32 x 5/16 x 1/8"; 5 used
	2-121841	NUT, 6-32 x 5/16 x 7/16"; 8 used
	2-10101A73	NUT, spring steel: 60 used
	2-84410P05	NUT speed 1/4-14; 20 used
	3-7312	SCREW, machine: 8-32 x 3/4"; 4 used
	3-132285	SCREW, machine: 6-32 x 7/16"; 4 used
	3-124074	SCREW, machine: 8-32 x 1/2"; 8 used
	3-122317	SCREW, machine: 8-32 x 1/4"; 5 used
	3-135038	SCREW, tapping: 14-14 x 3/4"; 20 used
	3-139549	SCREW, machine: 10-32 x 3/8"; 7 used
	3-139564	SCREW, cap: 3/8-24 x 1/2"; 8 used
	3-476083	SCREW, machine: 6-32 x 5/16"; 4 used
	4-7562	WASHER, flat: .188 x .438 x .33; 2 used
	4-7657	LOCKWASHER: #8 external: 4 used
	4-7668	LOCKWASHER: 3/8 external: 8 used
	4-84345A10	WASHER; 8 used
	5-82670M01	GROMMET: 2 used
	5-83885G01	RIVET; 2 used
	7-82003L01	BRACKET, ground
	7-82557M01	BRACKET, air filter: 10 used
	7-82558M01	BRACKET, power supply
	7-82559M01	BRACKET, mounting: 10 used
	9-82083C03	FUSEHOLDER: 4 used
	13-84430D01	GRILLE, ventilating: 10 used
	14-84562E03	INSULATOR, cover
	15-83445K06	CABINET, 60"
	29-848901	LUG, crimp terminal; 11 used
	42-10217A02	STRAP, tie: 4 used
	46-84561E02	STUD, hex; 4 used
	64-82627M03	PANEL, power supply
	64-84548K03	PANEL, blank
	64-84548K04	PANEL, blank: 2 used
	1-80711D86	FAN ASSEMBLY
	1-82838M02	FILTER, fan
	3-138133	SCREW, 6-32 × 3/4"; 4 used
	13-83028M01	GRILLE, fan guard
	33-83051K01	NAMEPLATE
	35-82668M01	FILTER, air: 10 used
	30-82687M01	JUMPER, terminal block (JU102)
	30-82687M02	JUMPER, terminal block (JU100, 101)
	59-82051A01	MOTOR, W/FAN; 120 V ac

TRN8693A Power Distribution Box Kit PL-7285-B

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		connector, receptacle
J100	9-891865	female, dual AC outlet
		switch:
S100	40-82041K01	dpdt toggle
		cable:
W100	30-83849E01	LINE CORD; includes plug
		mechanical parts
	1-80762B68	WIRE and LUG ASSEMBLY; includes:
	29-83883C02	LUG, crimp terminal: 2 used
	1-80762B69	WIRE and LUG ASSEMBLY; includes:
	29-812979	LUG crimp terminal: 2 used
	3-7365	SCREW, machine: 8-32 x 3/4"; 4 used
	3-127566	SCREW, machine: 10-32 x 1/4"; 2 used
	3-139564	SCREW, cap; 3/8-24 x 1/2"; 2 used
	4-7657	LOCKWASHER: #8 external; 2 used
	4-7668	LOCKWASHER: 3/8" external; 2 used
	7-84617H01	BOX OUTLET
	15-82025K01	COVER, switch
	29-84078B01	LUG, flanged spade: 3 used
	42-84618H01	CLAMP, cord
	64-82314L01	PLATE, power box mounting

TKN8011A AC Distribution Cable Kit PL-7286-A

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
	29-848901	LUG, crimp terminal; 4 used
	29-848902	LUG, crimp terminal
	37-82603D01	SLEEVING; coded #1; 2 used
	37-82603D02	SLEEVING; coded #2; 2 used
	37-82603D03	SLEEVING; coded #3
	37-82603D04	SLEEVING; coded #4
	37-82603D05	SLEEVING; coded #5
	42-10217A02	STRAP, tie; 5 used

TKN8012A DC Distribution Cable Kit PL-7287-A

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
	29-82008L02	LUG, ring tongue; 6 used
	29-847854	LUG, slitted tongue; 2 used
	29-848901	LUG, crimp terminal; 2 used
	30-812505	WIRE, battery #8; 23", 18" red
	30-851875	WIRE, battery #8; 19" black
	42-10217A02	STRAP, tie; 6 used

TRN8682A Ventilating Fan Kit PL-7290-B

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		fan assembly:
E100	1-80711D86	FAN and CORD ASSEMBLY includes:
	29-848902	LUG, crimp, terminal: 2 used
	30-83155H02	CABLE, 2 conductor: 24"
	59-82051A01	FAN
		mechanical parts
	2-132616	NUT, 6-32 x 1/4 x 3/32 x 1/8"; 4 used
	3-138133	SCREW, machine: 6-32 x 3/4"; 4 used
	7-82557M01	BRACKET, air filter: 8 used
	7-82692R01	BRACKET, fan mounting; 4 used
	13-83028M01	GRILLE, fan guard
	35-82668M01	FILTER, air: 8 used

TRN8668A AC Line Conditioner PL-7292-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
	1-82659M01	ASSEMBLY, line voltage regulator

THN6629A Housing & Hardware, *SMARTNET* PL-9995-A

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		fuse:
F1, 2	65-82654M01	8 amp; 250 V (slo-blow)
F3, 4	65-139837	3 amp; 250 V
		mechanical parts
	2-7003	NUT, 8-32 × 5/16 × 1/8"; 5 used
	2-121841	NUT, 6-32 × 5/16 × 7/64"; 4 used
	2-10101A73	NUT, spring: 60 used
	2-84410P05	NUT stamped; 1/4-14"; 20 used
	3-7312	SCREW, machine: 8-32 × 3/4"; 4 used
	3-132258	SCREW, machine: 6-32 × 7/16"; 4 used
	3-124674	SCREW, machine: 8-32 × 1/2"; 8 used
	3-129890	SCREW, lock: 10-32 × 3/8"; 7 used
	3-132285	SCREW, machine: 6-32 × 7/16"; 4 used
	3-135038	SCREW, tapping: 1/4-14 × 3/4"; 20 used
	3-138806	SCREW, lock, 8-32 × 5/16"; 5 used
	3-139564	SCREW, cap: 3/8-24 × 1/2"; 8 used
	3-476083	SCREW, lock: 6-32 × 5/16"; 4 used
	4-7562	WASHER, flat: 0.188 × 0.033"; 2 used
	4-7657	LOCKWASHER #8 external; 4 used
	4-7668	LOCKWASHER, 3/8" external; 8 used
	4-84345A10	WASHER, insulator; 8 used
	5-82670M01	GROMMET; 2 used
	7-82003L01	BRACKET, ground
	7-82557M01	BRACKET, air filter; 10 used
	7-82558M01	BRACKET, mounting; 2 used
	7-82692R01	BRACKET, fan support; 4 used
	9-72973C03	RECEPTACLE, fuse; 4 used
	13-84430D01	GRILLE; 10 used
	14-84562E03	INSULATOR, cover
	15-83445K06	CABINET, 60"
	29-848901	LUG, crimp red; 11 used
	29-824434	LUG, ring
	29-835302	LUG, ring
	30-865903	LINE CORD and PLUG
	30-82687M01	JUMPER, terminal block
	30-82687M02	JUMPER, terminal block; 2 used
	31-82522M01	TERMINAL, block
	31-82596E02	TERMINAL, block; 7 position
	33-83051K01	NAMEPLATE
	35-82668M01	FILTER, air; 10 used
	42-10217A02	STRAP, tie; 6 used
	46-84561E02	STUD, threaded; 4 used
	54-84119B01	LABEL, warn
	64-82627M04	PANEL
	66-84760P01	STRAP, wrist, static
	3-1930	SCREW, machine: 4-40 × 3/8"
	3-7542	SCREW, tapping: 8-15 × 3/8"; 2 used
	5-82275N01	GROMMET, plane
	64-84884M01	PLATE, side
	64-84885M02	PLATE, mounting
	1-80711D86	FAN ASSEMBLY
	3-138133	SCREW, 6-32 × 3/4"; 4 used
	13-83028M01	GRILLE, fan guard
	59-82051A01	MOTOR W/FAN, 120 V ac

note: For optimum performance, diodes, transistors, and integrated circuits must be ordered by Motorola part numbers.

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SAFE HANDLING OF CMOS INTEGRATED CIRCUIT DEVICES

Many of the integrated circuit devices used in communications equipment are of the CMOS (Complementary Metal Oxide Semiconductor) type. Because of their high open circuit impedance, CMOS ICs are vulnerable to damage from static charges. Care must be taken in handling, shipping, and servicing them and the assemblies in which they are used.

Even though protection devices are provided in CMOS IC inputs, the protection is effective only against overvoltage in the hundreds of volts range such as are encountered in an operating system. In a system, circuit elements distribute static charges and load the CMOS circuits, decreasing the chance of damage. *However, CMOS circuits can be damaged by improper handling of the modules even in a system.*

To avoid damage to circuits, observe the following handling, shipping, and servicing precautions.

1. Prior to and while servicing a circuit module, particularly after moving within the service area, momentarily touch *both* hands to a bare metal earth grounded surface. This will discharge any static charge which may have accumulated on the person doing the servicing.

NOTE
Wearing Conductive Wrist Strap (Motorola No. RSX-4015A) will minimize static buildup during servicing.

WARNING
When wearing Conductive Wrist Strap, be careful near sources of high voltage. The good ground provided by the wrist strap will also increase the danger of lethal shock from accidentially touching high voltage sources.

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5. All electrically powered test equipment should be grounded. *Apply* the *ground lead* from the test equipment to the circuit module *before* connecting the *test probe*. Similarly, *disconnect* the *test probe prior* to removing the *ground lead.*

6. If a circuit module is removed from the system, it is desirable to lay it on a conductive surface (such as a sheet of aluminum foil) which is connected to ground through 100k of resistance.

WARNING
If the aluminum foil is connected directly to ground, be cautious of possible electrical shock from contacting the foil at the same time as other electrical circuits.

7. When soldering, be sure the soldering iron is grounded.

8. Prior to connecting jumpers, replacing circuit components, or touching CMOS pins (if this becomes necessary in the replacement of an integrated circuit device), be sure to discharge any static buildup as described in procedure 1. Since voltage differences can exist across the human body, it is recommended that only one hand be used if it is necessary to touch pins on the CMOS device and associated board wiring.

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9. When replacing a CMOS integrated circuit device, leave the device in its metal rail container or conductive foam until it is to be inserted into the printed circuit module.

10. All low impedance test equipment (such as pulse generators, etc.) should be connected to CMOS device inputs after power is applied to the CMOS circuitry. Similarly, such low impedance equipment should be disconnected before power is turned off.

11. Replacement modules shipped separately from the factory will be packaged in a conductive material. Any modules being transported from one area to another should be wrapped in a simlar material (aluminum foil may be used). NEVER USE NON-CONDUCTIVE MATERIAL for packaging these modules.

MAINTENANCE

1. SYSTEM TEST

1.1 INTRODUCTION

1.1.1 This description and accompanying flowcharts facilitate the troubleshooting of a malfunctioning Trunked Radio System central controller. A trunked mobile unit and an oscilloscope are the only tools that are required for performing the fault diagnosis procedure presented in this section.

CAUTION
Many of the integrated circuit devices used in this equipment are vulnerable to damage from static charges. Care must be taken in handling, shipping, and servicing them and the assemblies in which they are used.

NOTE
Model TEN6081A Installation and Service Kit is available as an option to provide an extender board, to facilitate on-site module service and circuit tracing.

1.1.2 The central controller should at least be functional to the state such that it can initialize itself properly and remain in the idle state, waiting for call-related work. If the system is continually flashing its front panel LED's (due to resets) or if any Site Controller Board (SCB) module FAILURE LED's are active, this is an indication of a major system fault which must first be corrected before a call can be processed. In this case, proceed to the MAJOR FAILURE paragraphs of this section.

1.1.3 From this point onward, all faults and apparent failure conditions attempt to directly relate to indications a trunked mobile unit would experience while trying to process a normal call sequence.

1.1.4 Perform an indicator test via the front panel INDICATOR TEST pushbutton to verify that all indicators are functioning normally. Replace any defective parts.

NOTE
The ALARM CUTOFF pushbutton may be depressed to prevent activation of the alarms while troubleshooting.

1.1.5 Key the mobile unit to initiate a normal call sequence. If the mobile unit does not hear the busy tone nor the talk prohibit tone, proceed to the VOICE CHANNEL CALL PROCESSING paragraphs of this section. The busy tone heard, however, indicates that the mobile unit has received a busy OSW (outbound signaling word) from the central controller and is waiting for a grant OSW. In this case, proceed to the BUSY CONDITION PROCESSING paragraphs of this section.

1.2 TALK PROHIBIT TONE

When the mobile PTT is depressed, the mobile should transmit at least one ISW (inbound signaling word) to the central controller if it is capable of locking onto a valid control channel. If it sends only one ISW, it indicates that: (1) the control channel is functional, (2) the ISW was received and decoded properly, (3) an OSW grant was generated and sent to the mobile unit via the control channel, and (4) the mobile unit probably failed its handshake on the assigned voice channel. Proceed to the VOICE CHANNEL CALL PROCESSING paragraphs of this section.

1.3 MORE THAN ONE ISW SENT

1.3.1 If more than one ISW is sent by the mobile, this is an indication that the initial ISW is not being properly processed by the central processor. Key the mobile unit and observe the UNSQUELCH and DECODE indicators on the IRB (Inbound Recovery Board) module front panel. The UNSQUELCH indicator should flash each time the mobile transmits an ISW. If it does not, the IRB or the base repeater interface is at fault. The RIB (Receiver Interface Board) module circuit associated with the control channel should also flash with each ISW. If it does not, a base repeater interface problem should be suspected. Examine the receive signal lines of the repeater-central controller interconnect cable for proper operation. Even if it does flash, however, the ISW fault is probably with the IRB proper. After verifying data transmission from the base repeater to the IRB, replace the IRB and continue the test. If the UNSQUELCH indicator flashes, it indicates that a signal has been received by the repeater and that a decode attempt may be made by the IRB.

1.3.2 The DECODE indicator should flash each time the UNSQUELCH LED flashes to indicate that a proper decode is being performed by the IRB. If the DECODE indicator does not flash, check the data received at the IRB from the repeater. Improper data indicates a repeater-central controller interface problem, whereas proper data indicates a faulty IRB. In the second case, replace the faulty IRB and continue the test.

1.4 NO CONTROL CHANNEL

1.4.1 If no ISW is transmitted by the mobile unit, it indicates that the unit is unable to lock onto a valid control channel. The control channel should be indicated by one LED of the four possible CONTROL CHANNEL indicators being activated on the IRB. If the indicator has been activated, check the corresponding Transmitter Interface Board (TIB) module XMIT indicator for activity. If this indicator is illuminated, check the repeater-TIB interface to verify proper control of PTT and TDATA to the repeater. If the repeater is not keyed but is transmitting the TIB data, this is an indication of a faulty base repeater. If the XMIT indicator does not illuminate, it indicates a faulty TIB or Transmitter Site Controller (TSC) module. Place the TSC in the SERVICE mode by means of the front panel key switch. Enable and disable the channel by depressing the associated front panel pushbutton. The DISABLED indicator should correspond to the pushbutton switch position. If this cannot be done, try the pushbutton of another channel. If this functions normally, the TIB is at fault. Replace the TIB and repeat the test. If the TIB functions properly, the TSC could be at fault. Replace the TSC and continue the test.

1.4.2 If none of the CONTROL CHANNEL indicators are turned on, check for an enabled RIB-TIB pair (of the control channels set). If an RIB-TIB pair is not enabled, place both the Receive Site Controller (RSC) module and the TSC in the SERVICE mode by means of each associated front panel key switch, and enable the corresponding RIB-TIB pair by means of the associated front panel switch. If the status of this particular RIB (or TIB) cannot be changed, change the status of the other RIB (or TIB modules) in the system by repeating the foregoing procedure. If this cannot be done, the RSC (or TSC) is probably defective. Replace the defective module and continue the test.

1.4.3 If the RIB-TIB pair is enabled but none of the IRB CONTROL CHANNEL indicators are turned on, this is an indication of a faulty IRB or RSC. If the RSC can communicate the RIB information correctly, the IRB may be defective. Otherwise, the RSC is at fault. Replace the defective module and continue the test.

2. MAJOR FAILURE

2.1 This is an incapacitating type of failure, in which the system cannot maintain itself in a normal idle running condition. Typical symptoms would be one or more of the following:

- FAILURE indicator constantly active on an SCB. (Assuming the LED does *not* extinguish by momentarily turning the service enable switch to the SERVICE position, and then back to the RUN position.)

NOTE

The red FAILURE LED on an SCB lights and stays lit during *and after* an ordinary reset if a major central or repeater failure has occurred. The LED remains lit, even after the major failure is corrected and the system is functioning properly, until it is manually extinguished by momentarily turning the service enable switch to the SERVICE position and then back to the RUN position. However, after the major failure condition is corrected, and assuming no new major failure condition exists, the system continues to function properly, whether or not the FAILURE LED is extinguished.

- DISABLE indicator constantly active on an SCB
- pulsing FAILURE indicator on an SCB (resetting); indicators may flash on peripheral boards (RIB, TIB, others)
- no indicators are active in the system (the lamp test cannot activate the front panel indicators)

2.2 First, check the voltage levels provided by the four power supplies: +5 V#1, +5 V#2, +12 V#3, and -12 V#4. Adjust the power supplies as required to obtain the proper voltage levels. (See the Installation and Power Supply sections of this manual.)

2.3 Once the voltage levels have been verified (and corrected as required), an SCB should be assumed as a possible source of failure. Place all the SCB's in the SERVICE mode by means of the front panel keylock switch. Reset each SCB by depressing the associated front panel RESET pushbutton. Release the pushbutton. The SCB is in its initial, reset, service enabled condition.

2.4 Place the Central Site Controller (CSC) module in the RUN mode by means of the front panel key switch. If the RUN indicator extinguishes or if the FAILURE indicator illuminates, the SCB that was just enabled is at fault. Replace the SCB and repeat this test. If the CSC now functions normally, repeat the previous test for the RSC and TSC.

2.5 If all the sites appear to be functioning properly, even though no SCB modules have been replaced, this may indicate a faulty CSC (possibly an intermittent communication link).

3. MAJOR ALARM

3.1 The MAJOR ALARM is activated when a fault totally incapacitates the system or impairs its major functions. The following are typical major alarm faults:

- power supply failure (+5 V #1, +5 V #2, +12 V #3, or -12 V #4
- site controller failure (CSC, RSC, TSC)
- control channels failure:
  - — RF base repeater failure
  - — Repeater SCB interface failure
  - — IRB failure

NOTE

The MAJOR ALARM external indication can be blocked by means of the ALARM CUTOFF front panel switch on the CSC, unless either +5 V power supply has failed. This allows investigation of the alarm cause, without distraction of the audible alarm.

3.2 First, check the voltage levels of the power supplies and adjust or replace any defective units. After adjusting the power supplies, reset the system and check again.

3.3 Then, once the power supplies are functioning properly, check for a possible site failure. If the FAILURE indicator is illuminated on an SCB, this may indicate that this SCB and its associated peripheral modules are faulty.

3.4 If the SCB with the failure indication is the RSC, then the IRB, RIB, and RSC modules should be checked, as follows:

- If the FAILURE indicator on the IRB is illuminated, the failure is either in the IRB or the RSC. Replace these modules, one at a time, to determine which one is faulty. Proceed with the test.

- If all RIB channels indicate DISABLED mode, even though the front panel switches indicate an IN SERVICE status, check the RIB and RSC for faults. Replace these modules, one at a time, to isolate the faulty one. Proceed with the test.

- If only the FAILURE LED on the RSC is illuminated, the fault may be in the RSC. Replace the RSC and proceed with the test.

3.5 If the SCB with the failure indication is the TSC, then the TIB and TSC modules should be checked, as follows:

- If all TIB channels indicate DISABLED mode, even though the front panel switches indicate IN SERVICE status, the TIB or TSC may be at fault. Replace these modules, one at a time, to find the faulty one. Proceed with the test.

- If only the FAILURE LED on the TSC is illuminated, the fault may be in the TSC. Replace the TSC and proceed with the test.

- If the SCB with the failure indication is the CSC, then replace it and proceed with the test.

4. MINOR ALARM

The MINOR ALARM indicates the occurrence of a fault that does not cause total failure of the system. This alarm is activated when an enabled channel malfunctions, and such malfunction is detected by the RSC (illegal carrier detect signal) or by the TSC (transmitter power failure signal). The channel causing the alarm state is indicated on the front panel of the affected RIB or TIB. The DISABLED LED illuminates for a channel which has its CHANNEL pushbutton set in the ENABLE position. The alarm condition can be removed by disabling this channel by means of the associated front panel pushbutton on the RIB or TIB.

4.2 If the MINOR ALARM is activated without an apparent channel failure, look for a faulty SCB module. Initiate the on-board diagnostics for each SCB module (CSC, RSC, and TSC) and replace any defective modules. If all modules are found to be normal, check the alarm relay backplane circuitry for possible fault.

NOTE

The MINOR ALARM audible/visual indications can be disabled by operating the ALARM CUTOFF switch on the CSC.

5. BUSY CONDITION PROCESSING

5.1 The conditions for hearing the BUSY tone upon generation of a call request indicate that:

- the mobile was able to lock to a control channel
- the ISW from the mobile was processed normally
- the OSW sent to the mobile was valid

- no voice channels were available for assignment at the time of request
- the mobile might be disabled on the optional 'SAC' list.

NOTE

Some mobile units may be equipped to handle special types of calls that produce conditions and results which are different from the typical ones described for a standard subfleet call in this section.

5.2 If voice channels are available when a call request is made but a busy indication is generated by the central controller, this is an indication of subscriber or emergency programming denying access.

5.3 Manually enable a voice channel RIB-TIB pair. Place the RSC (or TSC) in SERVICE mode, by means of the front panel key switch, and enable the RIB (or TIB) by placing the channel IN SERVICE by means of the associated front panel switch. If the channel remains disabled, try to enable another channel on the same module. If this channel functions normally, the fault is probably in the RIB (or TIB). Replace the module and resume the test. If none of the channels respond properly, and replacement of the RIB (or TIB) does not correct the problem, the fault may be with the RSC (or TSC). Replace the RSC (or TSC) and resume the test. If this fails to rectify the problem, replace the CSC and resume the test. If the fault persists after replacing the RIB (or TIB), RSC (or TSC), and CSC, the central controller backplane may be at fault.

5.4 If a busy condition persists after the enabling of a channel, a problem may exist between the CSC and the TSC, as explained below:

- the CSC may not be sending the grant OSW to the TSC

- the TSC may not be responding to the OSW sent to it by the CSC.

5.5 Consequently, replace the CSC, and then the TSC. If this does not clear the problem, then the backplane may be at fault. Also check programming information in the central code plug booklet and the changes that have been made from the systems manager terminal.

6. VOICE CHANNEL CALL PROCESSING

6.1 INTRODUCTION

At this point, the mobile and system are functioning properly with regard to the transfer of information (ISW and OSW) via the control channel. The ISW request, which the mobile succeeds in transmitting, is transformed into an OSW grant that is sent via the control channel, directing the mobile to the available voice channel. The XMIT indicator on the TIB, which is associated with the voice channel, should turn on while the OSW grant is being processed. If this indicator stays extinguished, the TIB-TSC should be suspected for failure. Try to assign another voice channel to the mobile. If the XMIT indicator for this channel does not illuminate, the TIB is probably at fault. Replace the TIB and resume testing. If the fault persists after replacing the TIB, replace the TSC, and proceed with the test.

6.2 TALK PROHIBIT TONE

NOTE

It is assumed that the mobile unit has successfully transferred from the control channel to the voice channel.

Generation of a talk prohibit tone by the mobile unit indicates that the unit is unable to successfully complete its high-speed handshake with the central controller. Examine the mobile discriminator to determine if it is receiving a 3 kHz high-speed data word. If the received data appears to meet the high-speed data transmission requirements, the following modules should be suspected for faults, in the order shown: (1) TSC, (2) TIB, and (3) CSC. Replace the modules, one by one, in the order specified, to correct the fault. If replacement of these modules does not solve the problem, the fault may be directly related to the base repeater control. Check the TCM (Trunk Control Module) in the repeater for proper processing of the transmit data. If the signal received by the mobile seems distorted by noise, check the MUTE line from the TIB. The control line should be active during the high-speed handshake phase of the call. If this control line is not active, the TIB-TSC should be checked for failure. Replace these modules, one by one, to remove the fault.

6.3 IMPROPER HIGH-SPEED DATA RECEIVED BY MOBILE

6.3.1 Check the TDATA lines from the central controller to the base repeater. Check for active states on the PTT and MUTE lines. Any improper data on these lines may indicate a faulty TIB. Replace this module and resume the test. If the malfunction persists after replacing the TIB, replace the TSC and proceed with the test.

6.3.2 If the TDATA, PTT, and MUTE lines appear correct to the base repeater, the repeater should be checked for fault. Check the signal processing of the TCM. If it is found to be faulty, replace the TCM and proceed with the test. Otherwise, it is an rf problem. (Refer to the rf troubleshooting procedures presented in the Base Repeater Instruction Manual.)

6.4 NO TALK PROHIBIT TONE (TALK PERMIT/NO TONE)

6.4.1 This indicates that the mobile is satisfied with the high-speed data it received. The mobile then sends an 80 ms burst of high-speed connect tone to complete the handshake sequence. Upon completing the 80 ms burst of connect tone, the mobile transmits a continuous low-speed connect tone to keep the voice channel active.

6.4.2 The base repeater should be transmitting the low-speed connect word (along with the voice information) at this phase of the call. If it is still transmitting the high-speed connect word, it indicates that the central controller did not properly process the handshake. With the mobile keyed in this mode, the RCV indicator on the RIB that is associated with the voice channel should be lit since the mobile is in the transmit mode. If this indicator is not illuminated, the repeater-RIB interface or the base repeater receiver is at fault. If the carrier indicator signal is properly generated at the repeater, but not correctly processed at the RIB, replace the RIB and proceed with the test. Otherwise troubleshoot the receiver and TCM section of the repeater.

6.4.3 If the RCV indicator is illuminated, check the RDATA lines to determine if data is being properly transferred from the repeater discriminator to the RIB. If data transfer is not proper, check the TCM signal processing of the received data, as well as the receiver section of the base repeater. If the data transfer is apparently correct, check the RIB, RSC, and CSC for faults. Replace these modules, one at a time in the order mentioned, to determine the cause of the problem. Resume the test. If the fault persists, replace the TIB-TSC modules, one at a time to clear the fault.

6.4.4 When the channel switches from the high-speed data word to the low-speed data word, the transmitting mobile should be able to have its voice information repeated to the receiving mobiles. If the voice information is not repeated, check the MUTE line to the base repeater. If this line is active, the TIB-TSC may be at fault. Replace the TIB and resume the test. If the fault is still not cleared, replace the TSC also and resume the test.

6.4.5 If, after approximately 1.2 seconds, the base repeater terminates its low-speed connect word transmission in the unmuted sfate, this indicates that the RIB could not detect the low-speed connect tone. Replace the RIB and resume the test. If this does not rectify the fault, replace the RSC and proceed with the test.

6.4.6 Poor voice quality at this phase of the call indicates the need of retuning the base repeater circuitry. Refer to the Installation section in the Base Repeater Instruction Manual.

6.4.7 When the transmitting mobile dekeys, it transmits a disconnect tone burst to the base repeater. This tone should be detected by the repeater and used to initiate the muted disconnect sequence. If the MUTE line is not activated, this indicates that the disconnect tone was apparently not detected. Replace the RIB and resume testing. If this does not clear the fault, replace the RSC and proceed with the test. If the fault persists, replace the TIB-TSC modules, one at a time, to determine the source of the problem.

6.4.8 If the channel is set in the transmission trunked mode, the base repeater should immediately transmit the disconnect tone sequence. If the channel is set in the message trunked mode, the base repeater continues the transmission of the muted low-speed data word for the message trunked timeout time, and then transmits the muted disconnect sequence. If the repeater does not switch to the disconnect sequence, look for faults in the TIB, TSC, and CSC. Replace these modules, one at a time to clear the fault.

NOTE

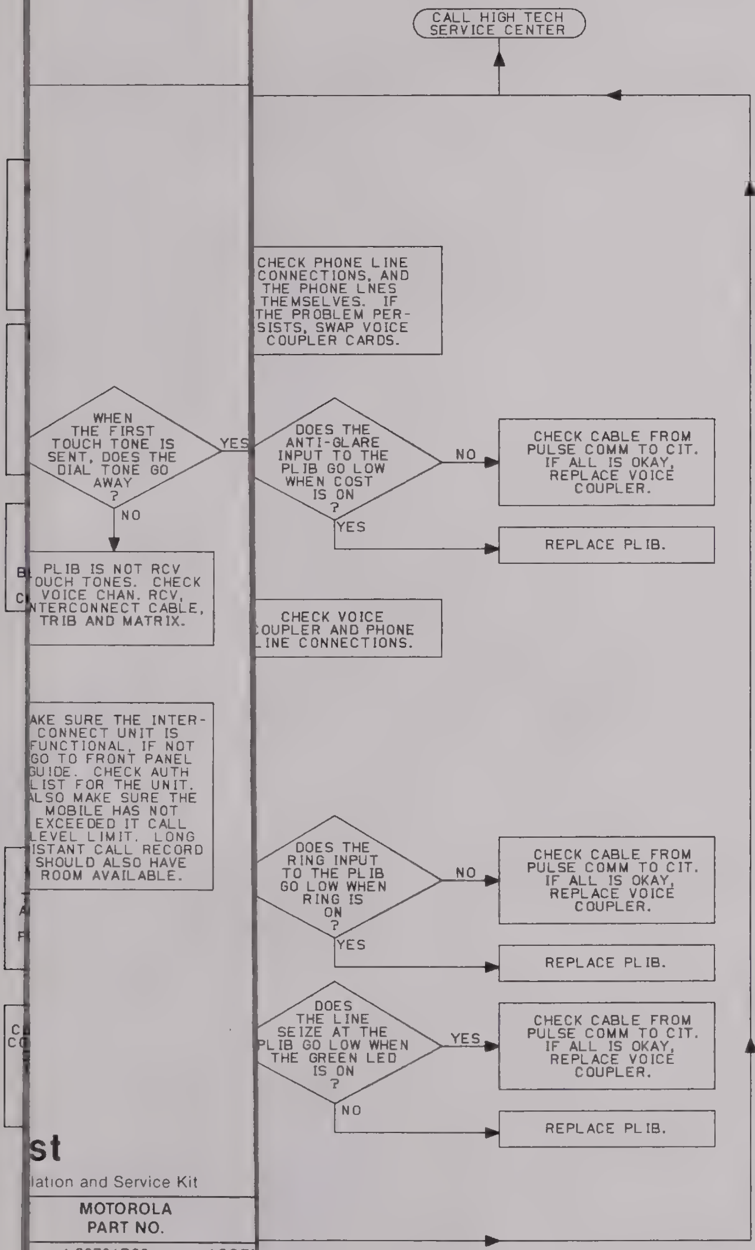
The call sequence is now completed. Release the ALARM CUTOFF switch.

6.5 FAILSOFT OPERATION

6.5.1 The base repeater enters failsoft operation if no transitions occur on the MUTE line from the TIB to the repeater. If the MUTE line is not being periodically pulsed, the TIB-TSC is at fault. Replace these modules one at a time to clear the fault.

6.5.2 If the MUTE line is being properly pulsed, the TCM in the appropriate base repeater is at fault. Replace the TCM and repeat the test.

TRUNKED RADIO SYSTEM
TROUBLESHOOTING CHART AND
SERVICE KIT PARTS LIST

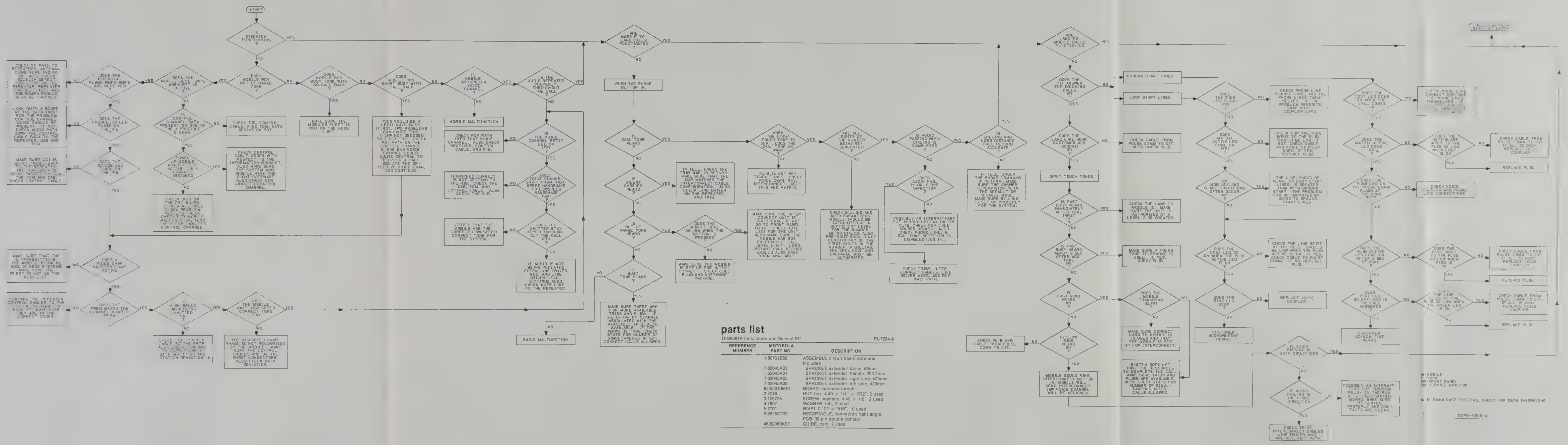

CALL HIGH TECH SERVICE CENTER
CHECK PHONE LINE CONNECTIONS, AND THE PHONE LNES THEMSELVES. IF THE PROBLEM PERSISTS, SWAP VOICE COUPLER CARDS.
WHEN THE FIRST TOUCH TONE IS SENT, DOES THE DIAL TONE GO AWAY ?
YES
NO
DOES THE ANTI-GLARE INPUT TO THE PLIB GO LOW WHEN COST IS ON ?
NO
YES
CHECK CABLE FROM PULSE COMM TO CIT. IF ALL IS OKAY, REPLACE VOICE COUPLER.
REPLACE PLIB.
PLIB IS NOT RCV OUCH TONES. CHECK VOICE CHAN. RCV, NTERCONNECT CABLE, TRIB AND MATRIX.
CHECK VOICE OUPLER AND PHONE LINE CONNECTIONS.
AKE SURE THE INTERCONNECT UNIT IS FUNCTIONAL, IF NOT GO TO FRONT PANEL GUIDE. CHECK AUTH LIST FOR THE UNIT. LSO MAKE SURE THE MOBILE HAS NOT EXCEEDED IT CALL LEVEL LIMIT. LONG ISTANT CALL RECORD SHOULD ALSO HAVE ROOM AVAILABLE.
DOES THE RING INPUT TO THE PLIB GO LOW WHEN RING IS ON ?
NO
YES
CHECK CABLE FROM PULSE COMM TO CIT. IF ALL IS OKAY, REPLACE VOICE COUPLER.
REPLACE PLIB.
DOES THE LINE SEIZE AT THE PLIB GO LOW WHEN THE GREEN LED IS ON ?
YES
NO
CHECK CABLE FROM PULSE COMM TO CIT. IF ALL IS OKAY, REPLACE VOICE COUPLER.
REPLACE PLIB.
-MOBILE
-PHONE
P-FRONT PANEL
M-SERVICE MONITOR
IN SIMULCAST SYSTEMS, CHECK FOR DATA INVERSIONS
EEPS-41518-A

st

lation and Service Kit

MOTOROLA PART NO.	
1-80761B66	ASSE includ
7-82045K03	BRAC
7-82045K04	BRAC
7-82045K05	BRAC
7-82045K06	BRAC
84-83010M01	BOAR
2-7019	NUT, h
3-125725	SCRE
4-7607	WASH
5-7701	RIVET,
9-88253C02	RECE PCB 3
46-82069K03	GUIDE

TRUNKED RADIO SYSTEM
TROUBLESHOOTING CHART AND SERVICE KIT PARTS LIST


START
IS DISPATCH FUNCTIONING ?
YES
NO
DOES MOBILE RCV OUT OF RANGE TONE ?
DOES THE MOBILE SEND ISW'S WHEN PTT IS ACTIVE ?
DOES THE RIB RSTAT FLASH WHEN ISW'S ARE RECEIVED ?
CHECK RF PATH TO REPEATERS, ANTENNA, COMBINERS AND SO ON. ALSO CHECK SQUELCH DETECT CIRCUITRY ON THE REPEATER. REPEATER CONTROL CABLE AND RIB BOARD SHOULD ALSO BE CHECKED.
DOES THE UNSQUELCH LED FLASH ON THE IRB ?
LOOK WITH A SCOPE AT THE DATA INPUT FOR THE PROBLEM CONTROL CHANNEL. NOISE SHOULD BE PRESENT. IF NOT, CHECK AUDIO PATH DOWN THE CONTROL CABLE BACK TO THE REPEATER, DAB AND TCM
DOES THE DECODE LED FLASH ON THE IRB ?
MAKE SURE CCI IS BEING PASSED BACK TO THE REPEATER AND THAT DATA IS BEING PASSED THROUGH THE TCM AND DAB. CHECK CONTROL CABLE
IS CONTROL CHANNEL DATA PRESENT ON ONE OF THE 4 POSSIBLE C CHAN ?
CHECK TIB, CONTROL CABLE, FIND TCM, DATA DEVIATION POT.
POWER UP MOBILE WHILE PTT IS ACTIVE. IS A CHANNEL ASSIGNED ?
CHECK CONTROL CABLE ORDER WITH RESPECT TO THE INFORMATION BOOKLET, ALSO MAKE SURE THE SYSTEM AND MOBILE HAVE THE RIGHT SOFTWARE ALSO CHECK FOR UNMUTED CONTROL CHANNEL.
CHECK JU15 ON THE CSC BOARD IF IN A MULTIPLE CLOCK PROBLEM RESULTS. ALSO CHECK FOR MOBILE MALFUNCTION, ALSO CHECK FOR UNMUTED CONTROL CHANNEL
DOES A VOICE CHAN XMITTER COME ACTIVE ?
MAKE SURE THAT THE ID TRANSMITTED BY THE MOBILE IS VALID, AND, IN 6800 SYSTEMS MAKE SURE THE FLEET IS NOT ON THE NEGS LIST.
DOES THE FREQ MATCH THE CHANNEL NUMBER FP SM ?
COMPARE THE REPEATER CONTROL CABLES TO THE SYSTEM INFORMATION BOOKLET. MAKE SURE THEY ARE IN THE CORRECT ORDER.
IS HIGH SPEED DATA BEING XMITTED SM ?
CHECK TIB CONTROL CABLE TO THE RPTR. ALSO CHECK TCM AND PA OUTPUT. CHECK DATA DEVIATION AND STATION DEVIATION. ◆
DOES THE MOBILE XMIT HIGH SPEED CONNECT TONE (SM) ?
THE HIGHSPEED HANDSHAKE IS NOT RECOGNIZED BY THE MOBILE. MAKE SURE THE CONTROL CABLES ARE ON THE RIGHT CONNECTORS. ALSO CHECK DATA DEVIATION.
DOES MOBILE RCV BUSY TONE WITH NO CALL BACK ?
MAKE SURE THE MOBILES FLEET IS NOT ON THE NEGS LIST.
DOES MOBILE RCV SHORT BUSY WITH CALL BACK ?
THIS COULD BE A LEGITIMATE BUSY, IF NOT, TWO PROBLEMS CAN CAUSE THIS. 1) ISW NOT DECODED ON FIRST TRY. CHECK RCV PATH ON THE CONTROL CHANNEL 2) ONE BAD VOICE CHANNEL COULD CAUSE CENTRAL TO REASSIGN A CALL. ISOLATE THE DEFECTIVE VOICE CHAN, AND CONTINUE.
IS MOBILE ASSIGNED A VOICE CHANNEL ?
MOBILE MALFUNCTION
IS THE AUDIO REPEATED PROPERLY, THROUGHOUT THE CALL ?
IS THE VOICE CHANNEL RSTAT LED ON (FP) ?
CHECK RCV PATH INTO THAT VOICE CHANNEL. ALSO CHECK RECEIVER, CONTROL CABLE, AND RIB.
DOES VOICE CHANNEL SHIFT FROM HIGH-SPEED HANDSHAKE TO LOWSPEED HANDSHAKE (SM) ?
HIGHSPEED CONNECT IS NOT GETTING TO THE RIB. CHECK THE DAB, TCM, AND CONTROL CABLE. ALSO CHECK THE RIB.
DOES THE XMITTER STAY KEYED THROUGHOUT THE CALL (FP) ?
VERIFY THAT THE MOBILE HAS THE CORRECT LOW SPEED CONNECT TONE FOR THE SYSTEM.
IF AUDIO IS NOT BEING REPEATED CHECK LINE DRIVER MOD AND LINE DRIVER LEVEL SITTINGS ALSO CHECK MUTE LINE TO THE REPEATER.
RADIO MALFUNCTION
ARE MOBILE TO LAND CALLS FUNCTIONING ?
PUSH THE PHONE BUTTON IN.
IS DIAL TONE HEARD ?
IS SILENT CARRIER HEARD ?
IN TELL, CHECK THE TRIB MAP, (R RETURN). MAKE SURE THAT THE MAP MATCHES THE INTERCONNECT CABLE CONFIGURATION. ALSO CHECK LINE DRIVER ON THE REPEATER, AND TRIB.
IS OUT OF RANGE TONE HEARD ?
DOES THE MOBILE SEND AN ISW WHEN THE BUTTON IS PRESSED ?
MAKE SURE THE MOBILE IS SET UP FOR INTERCONNECT. CHECK CODE PLUG AND SOFTWARE PACKAGE.
MAKE SURE THE INTERCONNECT UNIT IS FUNCTIONAL. IF NOT GO TO FRONT PANEL GUIDE. CHECK AUTH LIST FOR THE UNIT. ALSO MAKE SURE THE MOBILE HAS NOT EXCEEDED IT CALL LEVEL LIMIT. LONG DISTANT CALL RECORD SHOULD ALSO HAVE ROOM AVAILABLE.
IS BUSY TONE HEARD ?
MAKE SURE THERE ARE 1 OR MORE AVAILABLE TRIBS AND PLIBS. IF SO, IS THE RF CHANNEL ASSOCIATED WITH THE AVAILABLE TRIB, ALSO AVAILABLE. IF THE ABOVE IS TRUE, CHECK STATS FOR NUMBER OF SIMULTANEOUS INTERCONNECT CALLS ALLOWED.
WHEN THE FIRST TOUCH TONE IS SENT, DOES THE DIAL TONE GO AWAY ?
PLIB IS NOT RCV TOUCH TONES. CHECK VOICE CHAN RCV, INTERCONNECT CABLE, TRIB AND MATRIX.
ARE ALL DIGITS OF THE NUMBER BEING REGENERATED ?
CHECK BILLING AND AUTH PARAMETERS. MOBILE SHOULD BE AUTHORIZED AT A SUFFICIENT LEVEL FOR THE NUMBER BEING DIALED, ALSO PRE-DIGIT SHOULD NOT CONTAIN ANY OF THE FIRST DIGITS IN THE NUMBER IN BILLING. THE AREA CODE AND EXCHANGE MUST BE AUTHORIZED.
IS AUDIO PASSING WHEN DIALING IS COMPLETED ?
DOES AUDIO FAIL IN ONLY ONE DIRECTION ?
POSSIBLY AN INTERMITTANT CUT THROUGH RELAY ON THE PLIB. CHECK FOR COLD SOLDER JOINTS. ALSO CHECK PHONE LINE. IF DIAL TONE DETECTOR IS DISABLED (JU9 IN).
CHECK TRIBS, INTERCONNECT CABLES, LINE DRIVER MODS, AND RCV, XMIT PATH.
IS BILLING AND LONG DISTANCE CALL RECORD ACCURATE ?
IN TELL, UNDER THE PHONE COMMAND (P RETURN), MAKE SURE THE ANSWER SUPERVISION IS IN THE DEFAULT OR DISABLE MODE. MAKE SURE BILLING IS SET UP PROPERLY FOR THE SYSTEM.
ARE LAND TO MOBILE CALLS FUNCTIONING ?
DOES THE CIT ANSWER THE INCOMING CALLS (P) ?
GROUND START LINES
LOOP START LINES
DOES THE LAND LINE HEAR CUSTOMER ACK (2000HZ) (P) ?
CHECK CABLE FROM PULSE COMM TO CIT. ALSO CHECK PLIB
INPUT TOUCH TONES
IS FAST BUSY HEARD IMMEDIATELY AFTER TONE INPUT (P) ?
CHECK THE LAND TO MOBILE ID. MAKE SURE THE UNIT IS AUTHORIZED AT A LEVEL 2 OR GREATER.
IS FAST BUSY HEARD ABOUT 6 SEC AFTER ACK TONE (P) ?
MAKE SURE A TOUCH TONE TELEPHONE IS USED. IF YES, CHECK PLIB.
IS FAST RING HEARD (P) ?
DOES THE MOBILE TRANSPOND (M,FP) ?
MAKE SURE CORRECT LAND TO MOBILE ID IS USED AND THAT THE MOBILE IS SET UP FOR INTERCONNECT.
SYSTEM DOES NOT HAVE THE RESOURCES TO COMPLETE THE CALL. MAKE SURE TRIBS AND PLIBS ARE AVAILABLE. ALSO CHECK STATS FOR NUMBER OF SIMULTANEOUS INTERCALLS ALLOWED.
IS SLOW RING HEARD (P) ?
CHECK PLIB AND CABLE FROM PULSE COMM TO CIT.
MOBILE SOULD RING, INTERCONNECT BUTTON IN, MOBILE WILL SEND INTERCONNECT ISW VOICE CHANNEL WILL BE ASSIGNED.
DOES THE RING LED FLASH (FP) ?
CHECK PHONE LINE CONNECTIONS, AND THE PHONE LINES THEMSELVES. IF THE PROBLEM PERSISTS, SWAP VOICE COUPLER CARD
DOES MATRIX ACTIVE LED COME ON (FP) ?
CHECK FOR THE RING INPUT TO THE PLIB. SHOULD BE LOW, IF NOT, CHECK CABLE AND VOICE COUPLER CARD. IF YES, REPLACE PLIB.
DO MOBILE/LAND GLARE CONDITIONS OFTEN OCCUR (MP) ?
THE LIKELYHOOD OF GLARE ON LOOP START LINES, IS GREATER THAN WITH GROUND START. THE PROBLEM CAN BE IMPROVED BY GOING TO GROUND START LINES
DOES THE COST LED GO ON WHEN THE PLIB ACTIVE LED IS ON ?
CHECK THE LINE SEIZE AT THE PLIB. SHOULD BE LOW WHEN THE PLIB ACTIVE IS ON. IF YES, CHECK CABLE TO PULSE COMM. IF NO, REPLACE PLIB.
DOES THE RING LED STOP ?
REPLACE VOICE COUPLER.
CUSTOMER ACKNOWLEDGE HEARD.
IS AUDIO PASSING IN BOTH DIRECTIONS ?
IS AUDIO FAILING IN ONLY ONE DIRECTION ?
POSSIBLY AN INTERMITTENT CUT THROUGH RELAY ON THE PLIB. ALSO CHECK MATRIX BOARD, MAKE SURE ITS SEATED PROPERLY AND CONTACTS ARE CLEAN.
CHECK TRIBS, INTERCONNECT CABLES, LINE DRIVER MOD, AND RCV, XMIT PATH
DOES THE COST LED COME ON WHEN THE CALL COMES IN ?
CHECK PHONE LINE CONNECTIONS, AND THE PHONE LINES THEMSELVES. IF
DOES THE MATRIX ACTIVE LED COME ON ◆ ?
DOES THE ANTI-GLARE INPUT TO THE PLIB GO LOW WHEN COST IS ON ?
CHECK CABLE FROM PULSE COMM TO CIT IF ALL IS OKAY, REPLACE VOICE COUPLER
REPLACE PLIB
DOES THE RING LED ON THE PULSE COMM FLASH AT THE RING RATE ?
CHECK VOICE COUPLER AND PHONE LINE CONNECTIONS
DOES THE PLIB ACTIVE LED COME ON AFTER 2 SEC OF RING ?
DOES THE RING INPUT TO THE PLIB GO LOW WHEN RING IS ON ?
CHECK CABLE FROM PULSE COMM TO CIT IF ALL IS OKAY, REPLACE VOICE COUPLER
REPLACE PLIB.
DOES RING LED GO OFF, AND IS THE CALL ANSWERED ?
DOES THE LINE SEIZE AT THE PLIB GO LOW WHEN THE GREEN LED IS ON ?
CHECK CABLE FROM PULSE COMM TO CIT. IF ALL IS OKAY, REPLACE VOICE COUPLER.
REPLACE PLIB
CUSTOMER ACKNOWLEDGE HEARD

M-MOBILE
P-PHONE
FP-FRONT PANEL
SM-SERVICE MONITOR

◆ IN SIMULCAST SYSTEMS, CHECK FOR DATA INVERSIONS

EEPS-41518-A

parts list

TEN6081A Installation and Service Kit PL-7284-A

REFERENCE NUMBER	MOTOROLA PART NO.	DESCRIPTION
	1-80761B66	ASSEMBLY, circuit board extender includes
	7-82045K03	BRACKET, extender: brace, 46mm
	7-82045K04	BRACKET, extender: handle, 253.2mm
	7-82045K05	BRACKET, extender: right side, 420mm
	7-82045K06	BRACKET, extender: left side, 420mm
	84-83010M01	BOARD, extender circuit
	2-7019	NUT, hex: 4-40 × 1/4" × 3/32", 2 used
	3-125725	SCREW, machine: 4-40 × 1/2", 2 used
	4-7607	WASHER, felt, 2 used
	5-7701	RIVET: 0.122 × 3/16", 10 used
	9-88253C02	RECEPTACLE, connector: right angle; PCB 36-pin double contact
	46-82069K03	GUIDE, card: 2 used

DESCRIPTION, INSTALLATION & MAINTENANCE

DESCRIPTION 68P81040E02
INSTALLATION 68P81066E58
SAFE HANDLING OF CMOS INTEGRATED CIRCUIT DEVICES..............68P81106E84
MAINTENANCE 68P81040E04

CARD CAGE CHASSIS

21-CHANNEL CARD CAGE CHASSIS 68P81046E94

MODULES

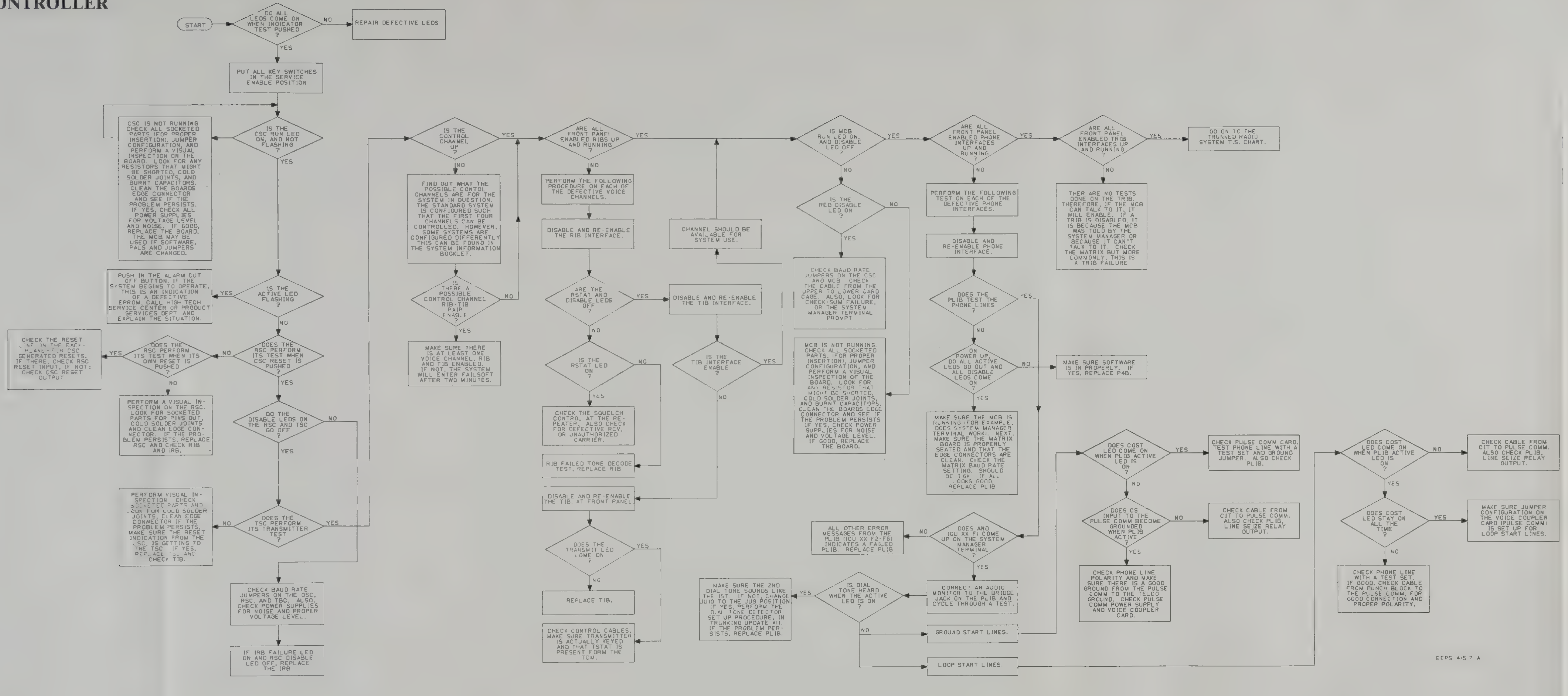
SITE CONTROLLER MODULES 68P81066E59
SITE CONTROLLER BOARD 68P81066E61
INBOUND RECOVER BOARD 68P81040E09
RECEIVER INTERFACE BOARD.....................................68P81040E11
TRANSMITTER INTERFACE BOARD 68P81040E12
ASYNCHRONOUS COMMUNICATIONS BOARD 68P81125E55
SITE INTERFACE BOARD...68P81125E56
SITE AUDIO BOARD 68P81125E57

POWER SUPPLIES

POWER SUPPLIES 68P81040E13

TRUNKED CENTRAL CONTROLLER

TROUBLESHOOTING CHART


START
DO ALL LEDS COME ON WHEN INDICATOR TEST PUSHED ?
NO
REPAIR DEFECTIVE LEDS
YES
PUT ALL KEY SWITCHES IN THE SERVICE ENABLE POSITION
IS THE CSC RUN LED ON, AND NOT FLASHING ?
CSC IS NOT RUNNING CHECK ALL SOCKETED PARTS (FOR PROPER INSERTION), JUMPER CONFIGURATION, AND PERFORM A VISUAL INSPECTION ON THE BOARD. LOOK FOR ANY RESISTORS THAT MIGHT BE SHORTED, COLD SOLDER JOINTS, AND BURNT CAPACITORS. CLEAN THE BOARDS EDGE CONNECTOR AND SEE IF THE PROBLEM PERSISTS. IF YES, CHECK ALL POWER SUPPLIES FOR VOLTAGE LEVEL AND NOISE. IF GOOD, REPLACE THE BOARD. THE MCB MAY BE USED IF SOFTWARE, PALS AND JUMPERS ARE CHANGED.
YES
IS THE ACTIVE LED FLASHING ?
YES
PUSH IN THE ALARM CUT OFF BUTTON. IF THE SYSTEM BEGINS TO OPERATE, THIS IS AN INDICATION OF A DEFECTIVE EPROM. CALL HIGH TECH SERVICE CENTER OR PRODUCT SERVICES DEPT AND EXPLAIN THE SITUATION.
NO
DOES THE RSC PERFORM ITS TEST WHEN CSC RESET IS PUSHED ?
NO
DOES THE RSC PERFORM ITS TEST WHEN ITS OWN RESET IS PUSHED ?
YES
CHECK THE RESET LINE ON THE BACKPLANE FOR CSC GENERATED RESETS. IF THERE, CHECK RSC RESET INPUT, IF NOT: CHECK CSC RESET OUTPUT
NO
PERFORM A VISUAL INSPECTION ON THE RSC. LOOK FOR SOCKETED PARTS FOR PINS OUT, COLD SOLDER JOINTS AND CLEAN EDGE CONNECTOR. IF THE PROBLEM PERSISTS, REPLACE RSC AND CHECK RIB AND IRB.
YES
DO THE DISABLE LEDS ON THE RSC AND TSC GO OFF ?
NO
YES
DOES THE TSC PERFORM ITS TRANSMITTER TEST ?
NO
PERFORM VISUAL INSPECTION. CHECK SOCKETED PARTS AND LOOK FOR COLD SOLDER JOINTS, CLEAN EDGE CONNECTOR IF THE PROBLEM PERSISTS, MAKE SURE THE RESET INDICATION FROM THE CSC, IS GETTING TO THE TSC. IF YES, REPLACE TSC AND CHECK TIB.
YES
CHECK BAUD RATE JUMPERS ON THE OSC, RSC, AND TBC. ALSO, CHECK POWER SUPPLIES FOR NOISE AND PROPER VOLTAGE LEVEL.
IF IRB FAILURE LED ON AND RSC DISABLE LED OFF, REPLACE THE IRB
IS THE CONTROL CHANNEL UP ?
NO
FIND OUT WHAT THE POSSIBLE CONTOL CHANNELS ARE FOR THE SYSTEM IN QUESTION. THE STANDARD SYSTEM IS CONFIGURED SUCH THAT THE FIRST FOUR CHANNELS CAN BE CONTROLLED. HOWEVER, SOME SYSTEMS ARE CONFIGURED DIFFERENTLY THIS CAN BE FOUND IN THE SYSTEM INFORMATION BOOKLET.
IS THERE A POSSIBLE CONTROL CHANNEL RIB-TIB PAIR ENABLE ?
NO
YES
MAKE SURE THERE IS AT LEAST ONE VOICE CHANNEL, RIB AND TIB ENABLED. IF NOT, THE SYSTEM WILL ENTER FAILSOFT AFTER TWO MINUTES.
YES
ARE ALL FRONT PANEL ENABLED RIBS UP AND RUNNING ?
NO
PERFORM THE FOLLOWING PROCEDURE ON EACH OF THE DEFECTIVE VOICE CHANNELS.
DISABLE AND RE-ENABLE THE RIB INTERFACE.
ARE THE RSTAT AND DISABLE LEDS OFF ?
YES
DISABLE AND RE-ENABLE THE TIB INTERFACE.
IS THE TIB INTERFACE ENABLE ?
YES
CHANNEL SHOULD BE AVAILABLE FOR SYSTEM USE.
NO
NO
IS THE RSTAT LED ON ?
NO
YES
CHECK THE SQUELCH CONTROL AT THE REPEATER, ALSO CHECK FOR DEFECTIVE RCV, OR UNAUTHORIZED CARRIER.
RIB FAILED TONE DECODE TEST, REPLACE RIB
DISABLE AND RE-ENABLE THE TIB, AT FRONT PANEL
DOES THE TRANSMIT LED COME ON ?
YES
NO
REPLACE TIB.
CHECK CONTROL CABLES, MAKE SURE TRANSMITTER IS ACTUALLY KEYED AND THAT TSTAT IS PRESENT FORM THE TCM.
YES
IS MCB RUN LED ON, AND DISABLE LED OFF ?
NO
IS THE RED DISABLE LED ON ?
NO
YES
CHECK BAUD RATE JUMPERS ON THE CSC AND MCB CHECK THE CABLE FROM THE UPPER TO LOWER CARD CAGE. ALSO, LOOK FOR CHECK-SUM FAILURE, OR THE SYSTEM MANAGER TERMINAL PROMPT
MCB IS NOT RUNNING. CHECK ALL SOCKETED PARTS, (FOR PROPER INSERTION), JUMPER CONFIGURATION, AND PERFORM A VISUAL INSPECTION OF THE BOARD. LOOK FOR ANY RESISTOR THAT MIGHT BE SHORTED, COLD SOLDER JOINTS, AND BURNT CAPACITORS. CLEAN THE BOARDS EDGE CONNECTOR AND SEE IF THE PROBLEM PERSISTS IF YES, CHECK POWER SUPPLIES FOR NOISE AND VOLTAGE LEVEL. IF GOOD, REPLACE THE BOARD.
YES
ARE ALL FRONT PANEL ENABLED PHONE INTERFACES UP AND RUNNING ?
NO
PERFORM THE FOLLOWING TEST ON EACH OF THE DEFECTIVE PHONE INTERFACES.
DISABLE AND RE-ENABLE PHONE INTERFACE.
DOES THE PLIB TEST THE PHONE LINES ?
YES
NO
ON POWER UP, DO ALL ACTIVE LEDS GO OUT AND ALL DISABLE LEDS COME ON ?
NO
MAKE SURE SOFTWARE IS IN PROPERLY. IF YES, REPLACE P4B.
YES
MAKE SURE THE MCB IS RUNNING (FOR EXAMPLE, DOES SYSTEM MANAGER TERMINAL WORK). NEXT, MAKE SURE THE MATRIX BOARD IS PROPERLY SEATED AND THAT THE EDGE CONNECTORS ARE CLEAN. CHECK THE MATRIX BAUD RATE SETTING. SHOULD BE 3.6K. IF ALL LOOKS GOOD, REPLACE PLIB
DOES AND ICU XX F1 COME UP ON THE SYSTEM MANAGER TERMINAL ?
NO
ALL OTHER ERROR MESSAGES FROM THE PLIB (ICU XX F2-F6) INDICATES A FAILED PLIB. REPLACE PLIB
YES
CONNECT AN AUDIO MONITOR TO THE BRIDGE JACK ON THE PLIB AND CYCLE THROUGH A TEST.
IS DIAL TONE HEARD WHEN THE ACTIVE LED IS ON ?
YES
MAKE SURE THE 2ND DIAL TONE SOUNDS LIKE THE 1ST. IF NOT, CHANGE JU10 TO THE JU9 POSITION IF YES, PERFORM THE DIAL TONE DETECTOR SET UP PROCEDURE, IN TRUNKING UPDATE #11. IF THE PROBLEM PERSISTS, REPLACE PLIB.
NO
GROUND START LINES.
LOOP START LINES.
YES
ARE ALL FRONT PANEL ENABLED TRIB INTERFACES UP AND RUNNING ?
YES
GO ON TO THE TRUNKED RADIO SYSTEM T.S. CHART.
NO
THER ARE NO TESTS DONE ON THE TRIB. THEREFORE, IF THE MCB CAN TALK TO IT, IT WILL ENABLE. IF A TRIB IS DISABLED, IT IS BECAUSE THE MCB WAS TOLD BY THE SYSTEM MANAGER OR BECAUSE IT CAN'T TALK TO IT. CHECK THE MATRIX BUT MORE COMMONLY, THIS IS A TRIB FAILURE
DOES COST LED COME ON WHEN PLIB ACTIVE LED IS ON ?
YES
CHECK PULSE COMM CARD. TEST PHONE LINE WITH A TEST SET AND GROUND JUMPER. ALSO CHECK PLIB.
NO
DOES CS INPUT TO THE PULSE COMM BECOME GROUNDED WHEN PLIB ACTIVE ?
NO
CHECK CABLE FROM CIT TO PULSE COMM. ALSO CHECK PLIB, LINE SEIZE RELAY OUTPUT.
YES
CHECK PHONE LINE POLARITY AND MAKE SURE THERE IS A GOOD GROUND FROM THE PULSE COMM TO THE TELCO GROUND. CHECK PULSE COMM POWER SUPPLY AND VOICE COUPLER CARD.
DOES COST LED COME ON WHEN PLIB ACTIVE LED IS ON ?
NO
CHECK CABLE FROM CIT TO PULSE COMM. ALSO CHECK PLIB, LINE SEIZE RELAY OUTPUT.
YES
DOES COST LED STAY ON ALL THE TIME ?
YES
MAKE SURE JUMPER CONFIGURATION ON THE VOICE COUPLER CARD (PULSE COMM) IS SET UP FOR LOOP START LINES.
NO
CHECK PHONE LINE WITH A TEST SET. IF GOOD, CHECK CABLE FROM PUNCH BLOCK TO THE PULSE COMM, FOR GOOD CONNECTION AND PROPER POLARITY.
EEPS 4157 A

DESCRIPTION, INSTALLATION & MAINTENANCE

DESCRIPTION 68P81040E02
INSTALLATION 68P81066E58
SAFE HANDLING OF CMOS INTEGRATED CIRCUIT DEVICES 68P81106E84
MAINTENANCE 68P81040E04

CARD CAGE CHASSIS

21-CHANNEL CARD CAGE CHASSIS 68P81046E94

MODULES

SITE CONTROLLER MODULES 68P81066E59
SITE CONTROLLER BOARD 68P81066E61
INBOUND RECOVER BOARD 68P81040E09
RECEIVER INTERFACE BOARD 68P81040E11
TRANSMITTER INTERFACE BOARD 68P81040E12
ASYNCHRONOUS COMMUNICATIONS BOARD 68P81125E55
SITE INTERFACE BOARD 68P81125E56
SITE AUDIO BOARD 68P81125E57

POWER SUPPLIES

POWER SUPPLIES 68P81040E13

MOTOROLA INC.
Communications
Sector

21-CHANNEL CARD CAGE CHASSIS

MODEL TLN2016A

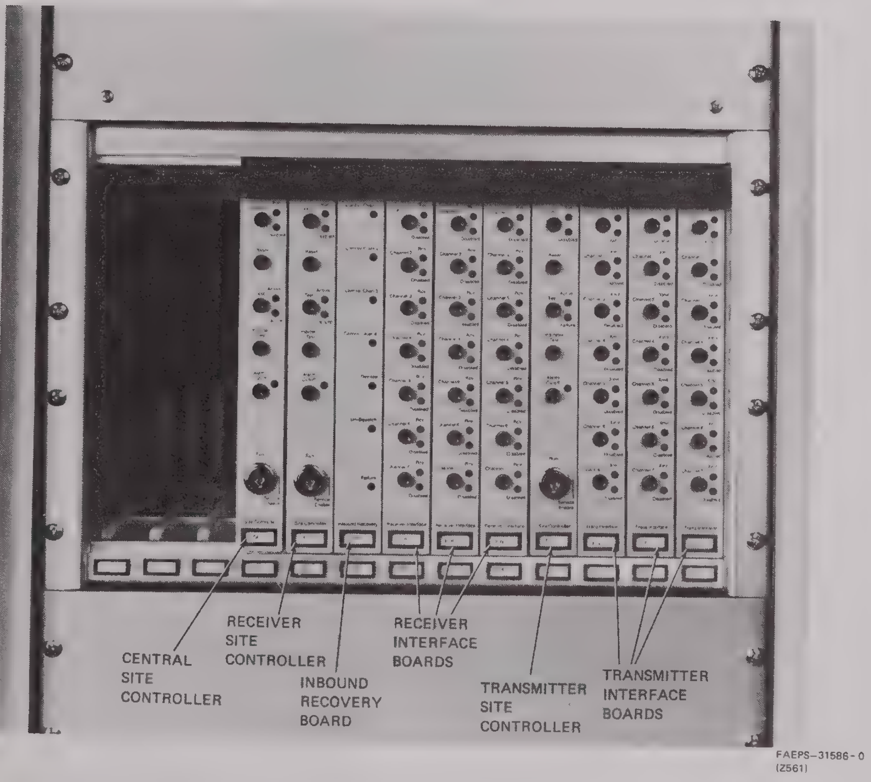

CENTRAL SITE CONTROLLER
RECEIVER SITE CONTROLLER
INBOUND RECOVERY BOARD
RECEIVER INTERFACE BOARDS
TRANSMITTER SITE CONTROLLER
TRANSMITTER INTERFACE BOARDS
FAEPS-31586-0
(Z561)

Figure 1. Typical Card Cage Chassis

1. DESCRIPTION

The Trunked Radio System Central Controller logic hardware and firmware is housed in a card cage chassis, as shown in Figure 1. The chassis can hold up to thirteen 10" x 12" plug-in modules. Module-to-module signal interconnection, power distribution, and peripheral equipment connection is provided via the 4-layer backplane interconnect board.

2. MODEL COMPLEMENT

Table 1 gives the model complement of Model TLN2016A Card Cage Chassis.

Table 1. Card Cage Model Complement

TLN2016A Card Cage Chassis
- TRN8664A Backplane Interconnect Board
- TRN8665A Card Cage Hardware Kit

BACKPLANE INTERCONNECT AND PARTS LISTS

TERCONNECT BOARD DETAIL
AND PARTS LISTS

J8
TSC
TTY
POSITI
13
T18
TB3
TB4
J41
CH 21
CH

SHOW

parts list

TRN8664A Backplane Interconnect Board PL-7283-O

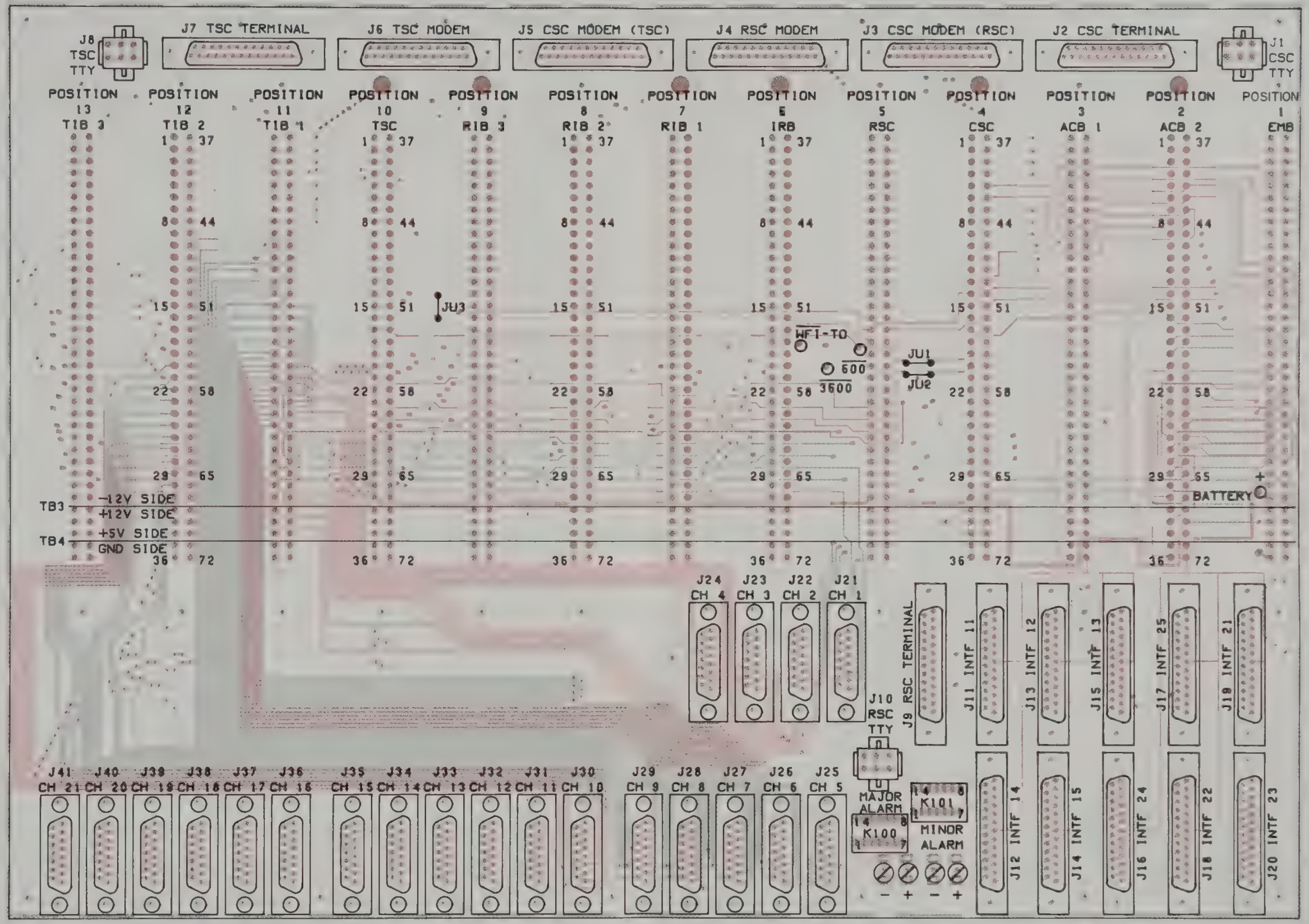
REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		connector, receptacle:
J1	28-10586A63	male, 6-contact; type TTY; (CSC)
J2 thru 7	28-10562A06	male, 25-contact; type RS-232-C
J8	28-10586A63	male, 6-contact; type TTY; (TSC)
J9	28-10562A06	male, 25-contact; type RS-232-C
J10	28-10586A63	male, 6-contact; type TTY; (RSC)
J11 thru 20	28-10562A06	male, 25-contact; type RS-232-C
J21 thru 41	28-10562A05	male, 15-contact; (CH1 thru CH21)
		relay:
K100, 101	80-84316F06	reed; form "A"; coil res. 500 ohm
		terminal board:
TB3	31-82334M01	12 V BUS BAR assembly (± 12 V)
TB4	31-82369M01	5 V BUS BAR assembly (+ 5, GND)
	mechanical parts	
	1-80711D81	21-CHANNEL CIRCUIT BOARD ASSEMBLY includes:
	29-83462G01	TERMINAL, plate: 4 used
	43-10392A14	INSERT, 4-40; 76 used
	3-115613	SCREW, machine: 4-40 x 1/4"; 4 used
	4-8412	LOCKWASHER, #4 split; 34 used
	9-84681F03	CONNECTOR, board, female: 13 used
	43-10646A08	STANDOFF, 4-40 x .438"; 76 used
	43-10646A09	STANDOFF, 4-40 x .188"; 34 used
	46-82512M01	STUD; 42 used
	46-84999F01	PLUG, polarizing; 26 used

TRN8665A Card Hardware Kit PL-6725-C

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
	1-84923F02	CARD CAGE, assembly
	2-84410P05	NUT, speed; 1/4-14; 8 used
	3-129498	SCREW, machine: 6-32 x 5/16"; 7 used
	3-135038	SCREW, tapping: 14-14 x 3/4"; 8 used
	3-136886	SCREW, machine: 4-40 x 3/8"; 33 used
	4-851702	WASHER, insulator; 5/16 x 1/8 x 5/64"; 5 used
	7-82265P01	BRACKET
	14-82562M01	INSULATOR, top panel
	14-82563M01	INSULATOR, bottom panel
	42-84837F01	CLIP; 13 used
	54-82877M01	LABEL, ID
	54-82613P01	LABEL
	54-84552P01	LABEL, control ID
	54-82548R01	LABEL, static caution
	61-84989F01	WINDOW, ID; 13 used
	75-82264P01	BUMPER

BACKPLANE INTERCONNECT BOARD DETAIL AND PARTS LISTS

INNER LAYER CIRCUIT BOARD DETAIL

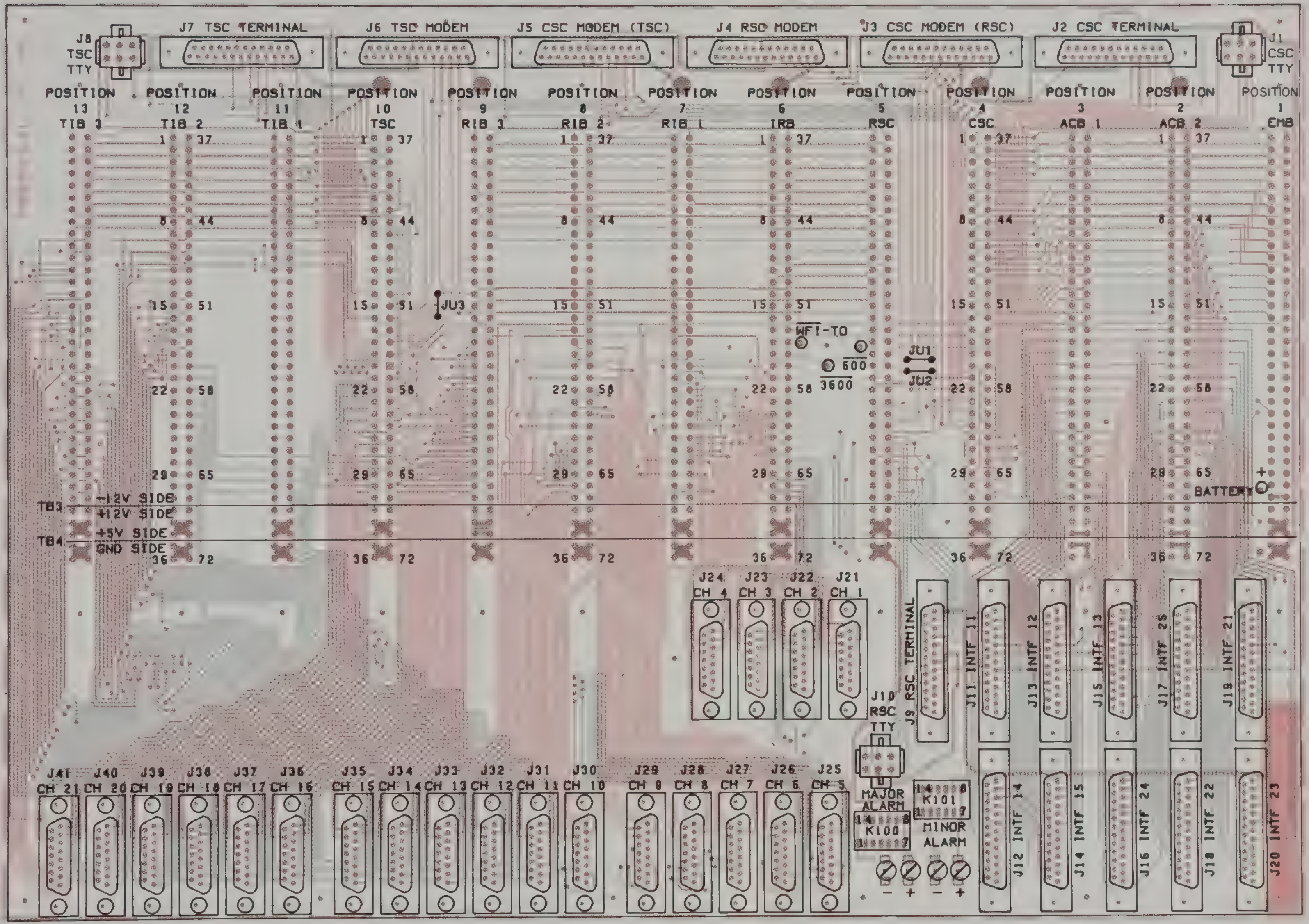

J8 TSC TTY
J7 TSC TERMINAL
J6 TSC MODEM
J5 CSC MODEM (TSC)
J4 RSC MODEM
J3 CSC MODEM (RSC)
J2 CSC TERMINAL
J1 CSC TTY
POSITION 13 TIB 3
POSITION 12 TIB 2
POSITION 11 TIB 1
POSITION 10 TSC
POSITION 9 RIB 3
POSITION 8 RIB 2
POSITION 7 RIB 1
POSITION 6 IRB
POSITION 5 RSC
POSITION 4 CSC
POSITION 3 ACB 1
POSITION 2 ACB 2
POSITION 1 EMB
JU3
WFI-TO
600
3600
JU1
JU2
BATTERY
TB3
TB4
-12V SIDE
+12V SIDE
+5V SIDE
GND SIDE
J24 CH 4
J23 CH 3
J22 CH 2
J21 CH 1
J9 RSC TERMINAL
J10 RSC TTY
J11 INTF 11
J13 INTF 12
J15 INTF 13
J17 INTF 25
J19 INTF 21
J12 INTF 14
J14 INTF 15
J16 INTF 24
J18 INTF 22
J20 INTF 23
MAJOR ALARM
K100
K101
MINOR ALARM
J41 CH 21
J40 CH 20
J39 CH 19
J38 CH 18
J37 CH 17
J36 CH 16
J35 CH 15
J34 CH 14
J33 CH 13
J32 CH 12
J31 CH 11
J30 CH 10
J29 CH 9
J28 CH 8
J27 CH 7
J26 CH 6
J25 CH 5

SHOWN FROM SOLDER SIDE

COMPONENT SIDE BD-DEPS-27413-A
SOLDER SIDE BD-DEPS-27414-A
OL-DEPS-26382-B

BACKPLANE INTERCONNECT BOARD DETAIL AND PARTS LISTS

OUTER LAYER CIRCUIT BOARD DETAIL


J8 TSC TTY
J7 TSC TERMINAL
J6 TSC MODEM
J5 CSC MODEM (TSC)
J4 RSC MODEM
J3 CSC MODEM (RSC)
J2 CSC TERMINAL
J1 CSC TTY
POSITION 13 TIB 3
POSITION 12 TIB 2
POSITION 11 TIB 1
POSITION 10 TSC
POSITION 9 RIB 3
POSITION 8 RIB 2
POSITION 7 RIB 1
POSITION 6 IRB
POSITION 5 RSC
POSITION 4 CSC
POSITION 3 ACB 1
POSITION 2 ACB 2
POSITION 1 EMB
JU3
WFI-TO
600
3600
JU1
JU2
BATTERY
TB3 −12V SIDE
+12V SIDE
TB4 +5V SIDE
GND SIDE
J24 CH 4
J23 CH 3
J22 CH 2
J21 CH 1
J10 RSC TTY
J9 RSC TERMINAL
J11 INTF 11
J13 INTF 12
J15 INTF 13
J17 INTF 25
J19 INTF 21
J41 CH 21
J40 CH 20
J39 CH 19
J38 CH 18
J37 CH 17
J36 CH 16
J35 CH 15
J34 CH 14
J33 CH 13
J32 CH 12
J31 CH 11
J30 CH 10
J29 CH 9
J28 CH 8
J27 CH 7
J26 CH 6
J25 CH 5
MAJOR ALARM
K100
K101
MINOR ALARM
J12 INTF 14
J14 INTF 15
J16 INTF 24
J18 INTF 22
J20 INTF 23

SHOWN FROM SOLDER SIDE

COMPONENT SIDE BD-DEPS-27413-A BD-DEPS-27415-A
SOLDER SIDE BD-DEPS-27414-A BD-DEPS-26381-A
OL-DEPS-26382-B

parts list

TRN8664A Backplane Interconnect Board PL-7283-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		connector, receptacle:
J1	28-10586A63	male, 6-contact; type TTY; (CSC)
J2 thru 7	28-10562A06	male, 25-contact; type RS-232-C
J8	28-10586A63	male, 6-contact; type TTY; (TSC)
J9	28-10562A06	male, 25-contact; type RS-232-C
J10	28-10586A63	male, 6-contact; type TTY; (RSC)
J11 thru 20	28-10562A06	male, 25-contact; type RS-232-C
J21 thru 41	28-10562A05	male, 15-contact; (CH1 thru CH21)
		relay:
K100, 101	80-84316F06	reed; form "A"; coil res. 500 ohm
		terminal board:
TB3	31-82334M01	12 V BUS BAR assembly (± 12 V)
TB4	31-82369M01	5 V BUS BAR assembly (+ 5, GND)
	mechanical parts	
	1-80711D81	21-CHANNEL CIRCUIT BOARD ASSEMBLY includes:
	29-83462G01	TERMINAL, plate: 4 used
	43-10392A14	INSERT, 4-40; 76 used
	3-115613	SCREW, machine: 4-40 x 1/4"; 4 used
	4-8412	LOCKWASHER, #4 split; 34 used
	9-84681F03	CONNECTOR, board, female: 13 used
	43-10646A08	STANDOFF, 4-40 x .438"; 76 used
	43-10646A09	STANDOFF, 4-40 x .188"; 34 used
	46-82512M01	STUD; 42 used
	46-84999F01	PLUG, polarizing; 26 used

TRN8665A Card Hardware Kit PL-6725-C

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
	1-84923F02	CARD CAGE, assembly
	2-84410P05	NUT, speed; 1/4-14; 8 used
	3-129498	SCREW, machine: 6-32 x 5/16"; 7 used
	3-135038	SCREW, tapping: 14-14 x 3/4"; 8 used
	3-136886	SCREW, machine: 4-40 x 3/8"; 33 used
	4-851702	WASHER, insulator; 5/16 x 1/8 x 5/64"; 5 used
	7-82265P01	BRACKET
	14-82562M01	INSULATOR, top panel
	14-82563M01	INSULATOR, bottom panel
	42-84837F01	CLIP; 13 used
	54-82877M01	LABEL, ID
	54-82613P01	LABEL
	54-84552P01	LABEL, control ID
	54-82548R01	LABEL, static caution
	61-84989F01	WINDOW, ID; 13 used
	75-82264P01	BUMPER

												RECEIVER SITE FUNCTIONS																																				
TGND 16	TDATA+16	TDATA-16	$\overline{\text{PTT}}$ 16	$\overline{\text{MUTE}}$ 16	TSTAT 17	TGND 17	TDATA+17	TDATA-17	$\overline{\text{PTT}}$ 17	$\overline{\text{MUTE}}$ 17		RSTAT 11	RGND 11	DISC 11	RRETN 11	CCI 11	IGND 11	RSTAT 12	RGND 12	DISC 12	RRETN 12	CCI 12	IGND 12	RSTAT 13	RGND 13	DISC 13	RRETN 13	CCI 13	IGND 13	RSTAT 14	RGND 14	DISC 14	RRETN 14	CCI 14	IGND 14	RSTAT 15	RGND 15	DISC 15	RRETN 15	RSTAT 16	RGND 16	DISC 16	RRETN 16	RSTAT 17	RGND 17	DISC 17	RRETN 17
CHANNEL 6					CHANNEL 7							CHANNEL 1						CHANNEL 2						CHANNEL 3						CHANNEL 4						CHANNEL 5				CHANNEL 6				CHANNEL 7			
18	*14	15	*17	*16	48	47	*12	13	*46	*45																																					
												18	19	57	56			22	23	58	60			26	27	62	61			59	30	64	63			20	21	66	65	25	24	55	54	29	28	53	17
														63	27	*28	64			62	26	*29	65			61	25	*30	66			60	24	*31	67												
												*1	9	*10	2	11	3																														
																		*1	9	*10	2	11	3																								
																								*1	9	*10	2	11	3																		
																														*1	9	*10	2	11	3												
																																				*1	9	*10	2								
8	14	7	6	13																																				*1	9	*10	2				
					*15	8	14	7	6	13																																		*1	9	*10	2

TGND 26	TDATA+26	TDATA-26	$\overline{\text{PTT}}$ 26	$\overline{\text{MUTE}}$ 26	TSTAT 27	TGND 27	TDATA+27	TDATA-27	$\overline{\text{PTT}}$ 27	$\overline{\text{MUTE}}$ 27		RSTAT 21	RGND 21	DISC 21	RRETN 21			RSTAT 22	RGND 22	DISC 22	RRETN 22			RSTAT 23	RGND 23	DISC 23	RRETN 23			RSTAT 24	RGND 24	DISC 24	RRETN 24			RSTAT 25	RGND 25	DISC 25	RRETN 25	RSTAT 26	RGND 26	DISC 26	RRETN 26	RSTAT 27	RGND 27	DISC 27	RRETN 27
CHANNEL 13					CHANNEL 14							CHANNEL 8						CHANNEL 9						CHANNEL 10						CHANNEL 11						CHANNEL 12				CHANNEL 13				CHANNEL 14			
18	*14	15	*17	*16	48	47	*12	13	*46	*45																																					
												18	19	57	56			22	23	58	60			26	27	62	61			59	30	64	63			20	21	66	65	25	24	55	54	29	28	53	17
												*1	9	*10	2																																
																		*1	9	*10	2																										
																								*1	9	*10	2																				
																														*1	9	*10	2														
																																				*1	9	*10	2								
8	14	7	6	13																																				*1	9	*10	2				
					*15	8	14	7	6	13																																		*1	9	*10	2

TGND 36	TDATA+36	TDATA-36	$\overline{\text{PTT}}$ 36	$\overline{\text{MUTE}}$ 36	TSTAT 37	TGND 37	TDATA+37	TDATA-37	$\overline{\text{PTT}}$ 37	$\overline{\text{MUTE}}$ 37		RSTAT 31	RGND 31	DISC 31	RRETN 31			RSTAT 32	RGND 32	DISC 32	RRETN 32			RSTAT 33	RGND 33	DISC 33	RRETN 33			RSTAT 34	RGND 34	DISC 34	RRETN 34			RSTAT 35	RGND 35	DISC 35	RRETN 35	RSTAT 36	RGND 36	DISC 36	RRETN 36	RSTAT 37	RGND 37	DISC 37	RRETN 37
CHANNEL 20					CHANNEL 21							CHANNEL 15						CHANNEL 16						CHANNEL 17						CHANNEL 18						CHANNEL 19				CHANNEL 20				CHANNEL 21			
18	*14	15	*17	*16	48	47	*12	13	*46	*45																																					
												18	19	57	56			22	23	58	60			26	27	62	61			59	30	64	63			20	21	66	65	25	24	55	54	29	28	53	17
												*1	9	*10	2																																
																		*1	9	*10	2																										
																								*1	9	*10	2																				
																														*1	9	*10	2														
																																				*1	9	*10	2								
8	14	7	6	13																																				*1	9	*10	2				
					*15	8	14	7	6	13																																		*1	9	*10	2

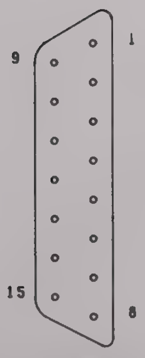
DEPS-27204-A

TROLLER TO BASE REPEATER AND EQUIPMENT INTERFACE

SITE TO BASE STATION CONNECTOR				TRANSMITTER SITE								
				TIB FUNCTIONS							RIB FUN	
SITE AFFECTED BOARD CHANNEL			FUNCTION	TSTAT	TGND	TDATA+ ✱	TDATA-	$\overline{\text{PTT}}$ ✱	$\overline{\text{MUTE}}$ ✱		RSTAT	
REPEATER TRUNKING CONTROL CABLE PIN #				✱ 15	8	14	7	6	13		✱ 1	
TIB 1 POS 11	RIB 1 POS 7	IRB POS 6	J21 CH1	28	29	26	27	31	30		18	1
			J22 CH2	20	21	24	25	22	23		22	2
			J23 CH3	67	66	62	63	65	64		26	2
			J24 CH4	56	57	60	61	58	59		59	3
			J25 CH5	55	54	50	51	53	52		20	2
			J26 CH6	19	18	14	15	17	16		25	2
			J27 CH7	48	47	12	13	46	45		29	2
TIB 2 POS 12	RIB 2 POS 8		J28 CH8	28	29	26	27	31	30		18	1
			J29 CH9	20	21	24	25	22	23		22	2
			J30 CH10	67	66	62	63	65	64		26	2
			J31 CH11	56	57	60	61	58	59		59	3
			J32 CH12	55	54	50	51	53	52		20	2
			J33 CH13	19	18	14	15	17	16		25	2
			J34 CH14	48	47	12	13	46	45		29	2
TIB 3 POS 13	RIB 3 POS 9		J35 CH15	28	29	26	27	31	30		18	1
			J36 CH16	20	21	24	25	22	23		22	2
			J37 CH17	67	66	62	63	65	64		26	2
			J38 CH18	56	57	60	61	58	59		59	3
			J39 CH19	55	54	50	51	53	52		20	2
			J40 CH20	19	18	14	15	17	16		25	2
			J41 CH21	45	47	12	13	46	45		29	2

NOTES

1. FUNCTION ✱ IDENTIFIES THE AFFECTED 'SITE BO
   THE GENERATOR OF THIS SIGNAL.
2. CONNECTOR PIN ✱ IDENTIFIES THE AFFECTED 'SI
   THE RECEIVER OF THIS SIGNAL.



SITE TO BASE REPEATER STATION CABLE CONNECTOR (PINS VIEWED FROM REAR OF CARD CAGE)

CENTRAL CONTROLLER TO BASE REPEATER INTERCONNECT CHART

			TRANSMITTER SITE FUNCTIONS																																									
		FUNCTION	TSTAT 11	TGND 11	TDATA+11	TDATA-11	$\overline{\text{PTT}}$ 11	$\overline{\text{MUTE}}$ 11	TSTAT 12	TGND 12	TDATA+12	TDATA-12	$\overline{\text{PTT}}$ 12	$\overline{\text{MUTE}}$ 12	TSTAT 13	TGND 13	TDATA+13	TDATA-13	$\overline{\text{PTT}}$ 13	$\overline{\text{MUTE}}$ 13	TSTAT 14	TGND 14	TDATA+14	TDATA-14	$\overline{\text{PTT}}$ 14	$\overline{\text{MUTE}}$ 14	TSTAT 15	TGND 15	TDATA+15	TDATA-15	$\overline{\text{PTT}}$ 15	$\overline{\text{MUTE}}$ 15	TSTAT 16	TGND 16	TDATA+16	TDATA-16	$\overline{\text{PTT}}$ 16	$\overline{\text{MUTE}}$ 16	TSTAT 17	TGND 17	TDATA+17	TDATA-17	$\overline{\text{PTT}}$ 17	$\overline{\text{MUTE}}$ 17
		POSITION	CHANNEL 1						CHANNEL 2						CHANNEL 3						CHANNEL 4						CHANNEL 5						CHANNEL 6						CHANNEL 7					
MODULE	TIB1	11	28	29	x 26	27	x 31	x 30	20	21	x 24	25	x 22	x 23	67	66	x 62	63	x 65	x 64	56	57	x 60	61	x 58	x 59	55	54	x 50	51	x 53	x 52	19	18	x 14	15	x 17	x 16	48	47	x 12	13	x 46	x 45
	RIB1	7																																										
	IRB	6																																										
CONNECTOR	J21	CH1	x 15	8	14	7	6	13																																		
	J22	CH2							x 15	8	14	7	6	13																												
	J23	CH3													x 15	8	14	7	6	13																						
	J24	CH4																			x 15	8	14	7	6	13																
	J25	CH5																									x 15	8	14	7	6	13										
	J26	CH6																															x 15	8	14	7	6	13						
	J27	CH7																																					x 15	8	14	7	6	13

			RECEIVER SITE FUNCTIONS																																			
		FUNCTION	RSTAT 11	RGND 11	DISC 11	RRETN 11	CCI 11	IGND 11	RSTAT 12	RGND 12	DISC 12	RRETN 12	CCI 12	IGND 12	RSTAT 13	RGND 13	DISC 13	RRETN 13	CCI 13	IGND 13	RSTAT 14	RGND 14	DISC 14	RRETN 14	CCI 14	IGND 14	RSTAT 15	RGND 15	DISC 15	RRETN 15	RSTAT 16	RGND 16	DISC 16	RRETN 16	RSTAT 17	RGND 17	DISC 17	RRETN 17
		POSITION	CHANNEL 1						CHANNEL 2						CHANNEL 3						CHANNEL 4						CHANNEL 5				CHANNEL 6				CHANNEL 7			
MODULE	TIB1	11																																		
	RIB1	7	18	19	57	56			22	23	58	60			26	27	62	61			59	30	64	63			20	21	66	65	25	24	55	54	29	28	53	17
	IRB	6			63	27	x 28	64			62	26	x 29	65			61	25	x 30	66			60	24	x 31	67												
CONNECTOR	J21	CH1	x 1	9	x 10	2	11	3																												
	J22	CH2							x 1	9	x 10	2	11	3																						
	J23	CH3													x 1	9	x 10	2	11	3																
	J24	CH4																			x 1	9	x 10	2	11	3										
	J25	CH5																									x 1	9	x 10	2								
	J26	CH6																													x 1	9	x 10	2				
	J27	CH7																																	x 1	9	x 10	2

			TRANSMITTER SITE FUNCTIONS																																									
		FUNCTION	TSTAT 21	TGND 21	TDATA+21	TDATA-21	$\overline{\text{PTT}}$ 21	$\overline{\text{MUTE}}$ 21	TSTAT 22	TGND 22	TDATA+22	TDATA-22	$\overline{\text{PTT}}$ 22	$\overline{\text{MUTE}}$ 22	TSTAT 23	TGND 23	TDATA+23	TDATA-23	$\overline{\text{PTT}}$ 23	$\overline{\text{MUTE}}$ 23	TSTAT 24	TGND 24	TDATA+24	TDATA-24	$\overline{\text{PTT}}$ 24	$\overline{\text{MUTE}}$ 24	TSTAT 25	TGND 25	TDATA+25	TDATA-25	$\overline{\text{PTT}}$ 25	$\overline{\text{MUTE}}$ 25	TSTAT 26	TGND 26	TDATA+26	TDATA-26	$\overline{\text{PTT}}$ 26	$\overline{\text{MUTE}}$ 26	TSTAT 27	TGND 27	TDATA+27	TDATA-27	$\overline{\text{PTT}}$ 27	$\overline{\text{MUTE}}$ 27
		POSITION	CHANNEL 8						CHANNEL 9						CHANNEL 10						CHANNEL 11						CHANNEL 12						CHANNEL 13						CHANNEL 14					
MODULE	TIB2	12	28	29	x 26	27	x 31	x 30	20	21	x 24	25	x 22	x 23	67	66	x 62	63	x 65	x 64	56	57	x 60	61	x 58	x 59	55	54	x 50	51	x 53	x 52	19	18	x 14	15	x 17	x 16	48	47	x 12	13	x 46	x 45
	RIB2	8																																										
CONNECTOR	J28	CH8	x 15	8	14	7	6	13																																		
	J29	CH9							x 15	8	14	7	6	13																												
	J30	CH10													x 15	8	14	7	6	13																						
	J31	CH11																			x 15	8	14	7	6	13																
	J32	CH12																									x 15	8	14	7	6	13										
	J33	CH13																															x 15	8	14	7	6	13						
	J34	CH14																																					x 15	8	14	7	6	13

			RECEIVER SITE FUNCTIONS																																			
		FUNCTION	RSTAT 21	RGND 21	DISC 21	RRETN 21			RSTAT 22	RGND 22	DISC 22	RRETN 22			RSTAT 23	RGND 23	DISC 23	RRETN 23			RSTAT 24	RGND 24	DISC 24	RRETN 24			RSTAT 25	RGND 25	DISC 25	RRETN 25	RSTAT 26	RGND 26	DISC 26	RRETN 26	RSTAT 27	RGND 27	DISC 27	RRETN 27
		POSITION	CHANNEL 8						CHANNEL 9						CHANNEL 10						CHANNEL 11						CHANNEL 12				CHANNEL 13				CHANNEL 14			
MODULE	TIB2	12																																		
	RIB2	8	18	19	57	56			22	23	58	60			26	27	62	61			59	30	64	63			20	21	66	65	25	24	55	54	29	28	53	17
CONNECTOR	J28	CH8	x 1	9	x 10	2																														
	J29	CH9							x 1	9	x 10	2																								
	J30	CH10													x 1	9	x 10	2																		
	J31	CH11																			x 1	9	x 10	2												
	J32	CH12																									x 1	9	x 10	2								
	J33	CH13																													x 1	9	x 10	2				
	J34	CH14																																	x 1	9	x 10	2

			TRANSMITTER SITE FUNCTIONS																																									
		FUNCTION	TSTAT 31	TGND 31	TDATA+31	TDATA-31	$\overline{\text{PTT}}$ 31	$\overline{\text{MUTE}}$ 31	TSTAT 32	TGND 32	TDATA+32	TDATA-32	$\overline{\text{PTT}}$ 32	$\overline{\text{MUTE}}$ 32	TSTAT 33	TGND 33	TDATA+33	TDATA-33	$\overline{\text{PTT}}$ 33	$\overline{\text{MUTE}}$ 33	TSTAT 34	TGND 34	TDATA+34	TDATA-34	$\overline{\text{PTT}}$ 34	$\overline{\text{MUTE}}$ 34	TSTAT 35	TGND 35	TDATA+35	TDATA-35	$\overline{\text{PTT}}$ 35	$\overline{\text{MUTE}}$ 35	TSTAT 36	TGND 36	TDATA+36	TDATA-36	$\overline{\text{PTT}}$ 36	$\overline{\text{MUTE}}$ 36	TSTAT 37	TGND 37	TDATA+37	TDATA-37	$\overline{\text{PTT}}$ 37	$\overline{\text{MUTE}}$ 37
		POSITION	CHANNEL 15						CHANNEL 16						CHANNEL 17						CHANNEL 18						CHANNEL 19						CHANNEL 20						CHANNEL 21					
MODULE	TIB3	13	28	29	x 26	27	x 31	x 30	20	21	x 24	25	x 22	x 23	67	66	x 62	63	x 65	x 64	56	57	x 60	61	x 58	x 59	55	54	x 50	51	x 53	x 52	19	18	x 14	15	x 17	x 16	48	47	x 12	13	x 46	x 45
	RIB3	9																																										
CONNECTOR	J35	CH15	x 15	8	14	7	6	13																																		
	J36	CH16							x 15	8	14	7	6	13																												
	J37	CH17													x 15	8	14	7	6	13																						
	J38	CH18																			x 15	8	14	7	6	13																
	J39	CH19																									x 15	8	14	7	6	13										
	J40	CH20																															x 15	8	14	7	6	13						
	J41	CH21																																					x 15	8	14	7	6	13

			RECEIVER SITE FUNCTIONS																																			
		FUNCTION	RSTAT 31	RGND 31	DISC 31	RRETN 31			RSTAT 32	RGND 32	DISC 32	RRETN 32			RSTAT 33	RGND 33	DISC 33	RRETN 33			RSTAT 34	RGND 34	DISC 34	RRETN 34			RSTAT 35	RGND 35	DISC 35	RRETN 35	RSTAT 36	RGND 36	DISC 36	RRETN 36	RSTAT 37	RGND 37	DISC 37	RRETN 37
		POSITION	CHANNEL 15						CHANNEL 16						CHANNEL 17						CHANNEL 18						CHANNEL 19				CHANNEL 20				CHANNEL 21			
MODULE	TIB3	13																																		
	RIB3	9	18	19	57	56			22	23	58	60			26	27	62	61			59	30	64	63			20	21	66	65	25	24	55	54	29	28	53	17
CONNECTOR	J35	CH15	x 1	9	x 10	2																														
	J36	CH16							x 1	9	x 10	2																								
	J37	CH17													x 1	9	x 10	2																		
	J38	CH18																			x 1	9	x 10	2												
	J39	CH19																									x 1	9	x 10	2								
	J40	CH20																													x 1	9	x 10	2				
	J41	CH21																																	x 1	9	x 10	2

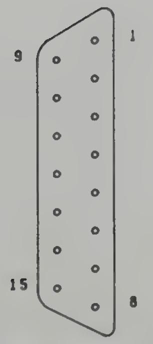
x INDICATES SIGNAL SOURCE

DEPS-27204-A

CENTRAL CONTROLLER TO BASE REPEATER AND EQUIPMENT INTERFACE

SITE TO BASE STATION CONNECTOR				TRANSMITTER SITE							RECEIVER SITE					
				TIB FUNCTIONS							RIB FUNC		RIB/IRB	RIB/IRB	IRB FUNC	
SITE AFFECTED BOARD CHANNEL			FUNCTION	TSTAT	TGND	TDATA+ ✱	TDATA-	$\overline{\text{PTT}}$ ✱	$\overline{\text{MUTE}}$ ✱		RSTAT	RGND	DISC	RRETN	CCI ✱	IGND
REPEATER TRUNKING CONTROL CABLE PIN #				✱ 15	8	14	7	6	13		✱ 1	9	✱ 10	2	11	3
TIB 1 POS 11	RIB 1 POS 7	IRB POS 6	J21 CH1	28	29	26	27	31	30		18	19	57/63	56/27	28	64
			J22 CH2	20	21	24	25	22	23		22	23	58/62	60/26	29	65
			J23 CH3	67	66	62	63	65	64		26	27	62/61	61/25	30	66
			J24 CH4	56	57	60	61	58	59		59	30	64/60	63/24	31	67
			J25 CH5	55	54	50	51	53	52		20	21	66	65		
			J26 CH6	19	18	14	15	17	16		25	24	55	54		
			J27 CH7	48	47	12	13	46	45		29	28	53	17		
TIB 2 POS 12	RIB 2 POS 8		J28 CH8	28	29	26	27	31	30		18	19	57	56		
			J29 CH9	20	21	24	25	22	23		22	23	58	60		
			J30 CH10	67	66	62	63	65	64		26	27	62	61		
			J31 CH11	56	57	60	61	58	59		59	30	64	63		
			J32 CH12	55	54	50	51	53	52		20	21	66	65		
			J33 CH13	19	18	14	15	17	16		25	24	55	54		
			J34 CH14	48	47	12	13	46	45		29	28	53	17		
TIB 3 POS 13	RIB 3 POS 9		J35 CH15	28	29	26	27	31	30		18	19	57	56		
			J36 CH16	20	21	24	25	22	23		22	23	58	60		
			J37 CH17	67	66	62	63	65	64		26	27	62	61		
			J38 CH18	56	57	60	61	58	59		59	30	64	63		
			J39 CH19	55	54	50	51	53	52		20	21	66	65		
			J40 CH20	19	18	14	15	17	16		25	24	55	54		
			J41 CH21	45	47	12	13	46	45		29	28	53	17		

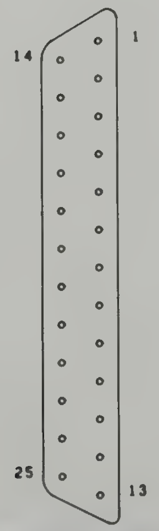
NOTES
1. FUNCTION ✱ IDENTIFIES THE AFFECTED 'SITE BOARD' AS THE GENERATOR OF THIS SIGNAL.
2. CONNECTOR PIN ✱ IDENTIFIES THE AFFECTED 'SITE BOARD' AS THE RECEIVER OF THIS SIGNAL.



SITE TO BASE REPEATER STATION
CABLE CONNECTOR
(PINS VIEWED FROM REAR OF CARD CAGE)

SIGNAL SOURCE BOARD							FUNCTION	RS-232C CONNECTORS								NOTE2	
EMB POS 1	CSC POS 4	RSL POS 5	TSC POS 10	ACB1 POS 3	ACB2 POS 2	CONNECTOR		TX ✱	RX	RTS ✱	CTS	DTR ✱	DSR	DCD	RI	TX CLOCK NOTE1	RX CLOCK NOTE1
RS-232C CONNECTOR PIN								2	✱ 3	4	✱ 5	20	✱ 6	✱ 8	✱ 22	✱ 24	✱ 17
	X					J2 CSC TERM		30	28	29	26	29		27			
	X					J3 CSC MODEM (RSC)		25	23	24	21	24		22			
		X				J4 RSC MODEM		25	23	24	21	24		22			
	X					J5 CSC MODEM (TSC)		61	59	60	57	60		58			
			X			J6 TSC MODEM		61	59	60	57	60		58			
			X			J7 TSC TERM		30	28	29	26	29		27			
		X				J9 RSC TERM		30	28	29	26	29		27			
				X		J11 INTF 11		47	48	49	50	46	51	52	45		
				X		J12 INTF 12		30	29	28	27	33	26	25	31		
				X		J13 INTF 13		58	57	56	55	59	54	53	60		
				X		J14 INTF 14		18	19	20	21	17	22	23	24		
				X		J15 INTF 15		63	64	69	67	62	66	65	61	19	18
					X	J16 INTF 21		47	48	49	50	46	51	52	45		
X						J17 INTF 22		30	28	29	26	24	21	27	22		
					X	J17 INTF 22		30	29	28	27	33	26	25	31		
					X	J18 INTF 23		58	57	56	55	59	54	53	60		
					X	J19 INTF 24		18	19	20	21	17	22	23	24		
X						J20 INTF 25		61	59	60	57	63	62	58	64	53	54
					X	J20 INTF 25		63	64	69	67	62	66	65	61	19	18

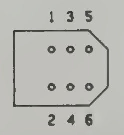
NOTES
1. WHEN USING INTF 15 – TX 14 IS THE RECEIVED DATA CLOCK
   RX 14 IS THE TRANSMIT DATA CLOCK
2. WHEN USING INTF 25 – TX 24 IS THE RECEIVED DATA CLOCK
   RX 24 IS THE TRANSMIT DATA CLOCK
3. FUNCTION ✱ IDENTIFIES THE 'SIGNAL SOURCE BOARD' AS THE GENERATOR OF THIS SIGNAL. CONNECTOR PIN ✱ IDENTIFIES THE 'SIGNAL SOURCE BOARD' AS THE RECEIVER OF THIS SIGNAL.



RS-232-C INTERFACE
CABLE CONNECTOR
(PINS VIEWED FROM REAR OF CARD CAGE)

SIGNAL SOURCE BOARD				FUNCTION	20 MA CURRENT LOOP			
CSC POS 4	RSC POS 5	TSC POS 10	CONNECTOR		SERIAL DATA OUT ✱ (SDO)	SERIAL DATA IN (SDI)	READER CONTROL ✱ (RC)	TTY COMMON NOTE1 ✱ (-12V)
TELETYPE CONNECTOR PIN					6	✱ 3	2	1
X			J1 CSC TTY		62	63	64	67
		X	J8 TSC TTY		62	63	64	67
	X		J10 RSC TTY		62	63	64	67

NOTES
1. READER COMMON APPEARS ON CONNECTOR PIN 4.
2. FUNCTION ✱ IDENTIFIES THE 'SIGNAL SOURCE BOARD' AS THE GENERATOR OF THIS SIGNAL. CONNECTOR PIN ✱ IDENTIFIES THE 'SIGNAL SOURCE BOARD' AS THE RECEIVER OF THIS SIGNAL.



TTY INTERFACE
CABLE CONNECTOR
(PINS VIEWED FROM REAR OF CARD CAGE)

INTERFACE TO TEN OPTIONS
(EMB USES ACB#2.PORTS 2 AND 5)

ASYNCHRONOUS 2 INTERFACES 11/21								ASYNCHRONOUS 2 INTERFACES 12/22								ASYNCHRONOUS 2 INTERFACES 13/23								ASYNCHRONOUS 2.3 INTERFACES 14/24								SYNCHRONOUS 2.3 INTERFACES 15/25							
TX 11/21	RX 11/21	RTS 11/21	CTS 11/21	QTR 11/21	DSR 11/21	DCD 11/21	RI 11/21	TX 12/22	RX 12/22	RTS 12/22	CTS 12/22	DTR 12/22	DSR 12/22	DCD 12/22	RI 12/22	TX 13/23	RX 13/23	RTS 13/23	CTS 13/23	DTR 13/23	DSR 13/23	DCD 13/23	RI 13/23	TX3 14/24	RX3 14/24	RTS 14/24	CTS 14/24	DTR 14/24	DSR 14/24	DCD 14/24	RI 14/24	TX 15/25	RX 15/25	RTS 15/25	CTS 15/25	DTR 15/25	DSR 15/25	DCD 15/25	RI 15/25
X 47	48	X 49	50	X 46	51	52	45	X 30	29	X 28	27	X 33	26	25	31	X 58	57	X 56	55	X 59	54	53	60	X 18	19	X 20	21	X 17	22	23	24	63	64	X 69	67	X 62	66	65	61
								30	28	29	26	24	21	27	22																	61	59	60	57	63	62	58	64
2	X 3	4	X 5	20	X 6	X 8	X 22																																
																								2	X 3	4	X 5	20	X 6	X 8	X 22								
								2	X 3	4	X 5	20	X 6	X 8	X 22																								
																								X 17	X 24							2	X 3	4	X 5	20	X 6	X 8	X 22
																2	X 3	4	X 5	20	X 6	X 8	X 22																
																								2	X 3	4	X 5	20	X 6	X 8	X 22								
																								X 17	X 24							2	X 3	4	X 5	20	X 6	X 8	X 22
								2	X 3	4	X 5	20	X 6	X 8	X 22																								
2	X 3	4	X 5	20	X 6	X 8	X 22																																
																2	X 3	4	X 5	20	X 6	X 8	X 22																

DEPS-38810-0

CENTRAL CONTROLLER
ND INTERSITE CONNECTIONS

CENTRAL CONTROLLER TO EQUIPMENT INTERCONNECT CHART

SIGNAL NAME CONNECTION				EXPANSION CONNECTIONS TO REMOTE SITES AND LOCAL SITE CONTROLLER																
				CENTRAL SITE MODEM RECEIVER SITE						CENTRAL SITE MODEM TRANSMITTER SITE						RECEIVER SITE TO TRANSMITTER SITE				
MODULE	SIGNAL GROUND	CHASSIS GND.		TX CMR	RX CMR	RTS CMR	CTS CMR	DCD CMR	DCD MR	TX CMT	RX CMT	RTS CMT	CTS CMT	DCD CMT	DCD MT	TX RTS	RX RTS	RTS RTS	CTS RTS	DCD RTS
CSC	35-36 71-72			X 25	23	X 24	21	22		X 61	59	X 60	57	58						
ACB 1/2	35 71-72																			
EMB	35 71-72																			
RSC	35-36 71-72			23	X 25	21	X 24		22							X 61	59	X 60	57	
TSC	35-36 71-72									59	X 61	57	X 60		58	23	X 25	21	X 24	
CONNECTOR																				
J2 CSC TERM	7	1																		
J3 CSC RSC	7	1		2	X 3	4 20	X 5	X 8												
J4 RSC MODEM	7	1		X 3	2	X 5	4 20		X 8											
J5 CSC TSC	7	1								2	X 3	4 20	X 5	X 8						
J6 TSC MODEM	7	1								X 3	2	X 5	4 20		X 8					
J7 TSC TERM	7	1																		
J9 RSC TERM	7	1																		
J11 INTF 11	7	1																		
J12 INTF 14	7	1																		
J13 INTF 12	7	1																		
J14 INTF 15	7	1																		
J15 INTF 13	7	1																		
J16 INTF 24	7	1																		
J17 INTF 25	7	1																		
J18 INTF 22	7	1																		
J19 INTF 21	7	1																		
J20 INTF 23	7	1																		

SIGNAL NAME CONNECTION	SITE CONTROLLER TERMINAL (PAIRED PER SITE)															INTERFACE TO TEN OPTIONS (EMB USES ACB#2,PORTS 2 AND 5)							
	CENTRAL SITE TO TERMINAL					RECEIVER SITE TO TERMINAL					TRANSMITTER SITE TO TERMINAL					ASYNCHRONOUS 2 INTERFACES 11/21							
MODULE	TX CTE	RX CTE	RTS CTE	CTS CTE	DCD CTE	TX RTE	RX RTE	RTS RTE	CTS RTE	DCD RTE	TX TTE	RX TTE	RTS TTE	CTS TTE	DCD TTE	TX 11/21	RX 11/21	RTS 11/21	CTS 11/21	QTR 11/21	DSR 11/21	DCD 11/21	RI 11/21
CSC	X 30	28	X 29	26	27																		
ACB 1/2																X 47	48	X 49	50	X 46	51	52	45
EMB																							
RSC						X 30	28	X 29	26	27													
TSC											X 30	28	X 29	26	27								
CONNECTOR																							
J2 CSC TERM	2	X 3	4 20	X 5	X 8																		
J3 CSC RSC																							
J4 RSC MODEM																							
J5 CSC TSC																							
J6 TSC MODEM																							
J7 TSC TERM											2	X 3	4 20	X 5	X 8								
J9 RSC TERM						2	X 3	4 20	X 5	X 8													
J11 INTF 11																2	X 3	4	X 5	20	X 6	X 8	X 22
J12 INTF 14																							
J13 INTF 12																							
J14 INTF 15																							
J15 INTF 13																							
J16 INTF 24																							
J17 INTF 25																							
J18 INTF 22																							
J19 INTF 21																2	X 3	4	X 5	20	X 6	X 8	X 22
J20 INTF 23																							

SIGNAL NAME CONNECTION	ASYNCHRONOUS 2 INTERFACES 12/22								ASYNCHRONOUS 2 INTERFACES 13/23							
MODULE	TX 12/22	RX 12/22	RTS 12/22	CTS 12/22	DTR 12/22	DSR 12/22	DCD 12/22	RI 12/22	TX 13/23	RX 13/23	RTS 13/23	CTS 13/23	DTR 13/23	DSR 13/23	DCD 13/23	RI 13/23
CSC																
ACB 1/2	X 30	29	X 28	27	X 33	26	25	31	X 58	57	X 56	55	X 59	54	53	60
EMB	30	28	29	26	24	21	27	22								
RSC																
TSC																
CONNECTOR																
J2 CSC TERM																
J3 CSC RSC																
J4 RSC MODEM																
J5 CSC TSC																
J6 TSC MODEM																
J7 TSC TERM																
J9 RSC TERM																
J11 INTF 11																
J12 INTF 14																
J13 INTF 12	2	X 3	4	X 5	20	X 6	X 8	X 22								
J14 INTF 15																
J15 INTF 13									2	X 3	4	X 5	20	X 6	X 8	X 22
J16 INTF 24																
J17 INTF 25																
J18 INTF 22	2	X 3	4	X 5	20	X 6	X 8	X 22								
J19 INTF 21																
J20 INTF 23									2	X 3	4	X 5	20	X 6	X 8	X 22

SIGNAL NAME CONNECTION	ASYNCHRONOUS 2,3 INTERFACES 14/24								SYNCHRONOUS 2,3 INTERFACES 15/25							
MODULE	TX3 14/24	RX3 14/24	RTS 14/24	CTS 14/24	DTR 14/24	DSR 14/24	DCD 14/24	RI 14/24	TX 15/25	RX 15/25	RTS 15/25	CTS 15/25	DTR 15/25	DSR 15/25	DCD 15/25	RI 15/25
CSC																
ACB 1/2	X 18	19	X 20	21	X 17	22	23	24	63	64	X 69	67	X 62	66	65	61
EMB									61	59	60	57	63	62	58	64
RSC																
TSC																
CONNECTOR																
J2 CSC TERM																
J3 CSC RSC																
J4 RSC MODEM																
J5 CSC TSC																
J6 TSC MODEM																
J7 TSC TERM																
J9 RSC TERM																
J11 INTF 11																
J12 INTF 14	2	X 3	4	X 5	20	X 6	X 8	X 22								
J13 INTF 12																
J14 INTF 15	X 17	X 24							2	X 3	4	X 5	20	X 6	X 8	X 22
J15 INTF 13																
J16 INTF 24	2	X 3	4	X 5	20	X 6	X 8	X 22								
J17 INTF 25	X 17	X 24							2	X 3	4	X 5	20	X 6	X 8	X 22
J18 INTF 22																
J19 INTF 21																
J20 INTF 23																

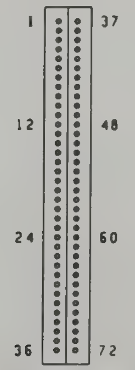
DEPS-38810-0

1. ALL SIGNAL NAMES REFER TO FUNCTION ON FIRST NAMED BOARD
E.G. 'TX CMR' IS TRANSMITTED DATA AT CENTRAL SITE CONTROLLER. RECEIVED DATA BY RECEIVER SITE CONTROLLER
ALL RS-232-C CONNECTORS ARE CONFIGURED AS D.T.E.
2. ASYNCHRONOUS AND SYNCHRONOUS INTERFACES REFER TO THE ACB NUMBER AND TO A SPECIFIC INTERFACE
E.G. INTF 23 IS INTERFACE 3 ON ACB2
3. WHEN USING INTF 15 { TX14 IS THE RECEIVED DATA CLOCK
RX14 IS THE TRANSMITTED DATA CLOCK
WHEN USING INTF 25 { TX24 IS THE RECEIVED DATA CLOCK
RX24 IS THE TRANSMITTED DATA CLOCK
4. X INDICATES SIGNAL SOURCE

CENTRAL CONTROLLER
INTRASITE AND INTERSITE CONNECTIONS

			INTER-SITE SIGNALS (NOTE 1)															INTRA-SITE SIGNALS (NOTE 1)																																						
MODULE POSITION		FUNCTION	SIGNAL GROUND	+5V	+12V	-12V	600 (NOTE 2)	WFI (NOTE 2)	3600 (NOTE 2)	RST0 (NOTE 3)	RST1 (NOTE 3)	RST1 (NOTE 3)	LAMP TEST	MAJOR ALARM	MINOR ALARM	RSC MAJOR (NOTE 4)	RSC MINOR (NOTE 4)	D0 (NOTE 5)	D1 (NOTE 5)	D2 (NOTE 5)	D3 (NOTE 5)	D4 (NOTE 5)	D5 (NOTE 5)	D6 (NOTE 5)	D7 (NOTE 5)	A0	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12	A13	A14	XA15	VMA	ADEC	R/W	E	Q	IRQ (NOTE 5)	XNMI	1843.2KHZ	PAGE 1	PAGE 2	288KHZ	B+ (BATTERY)		RELAY +	RELAY -
CENTRAL SITE	EMB	1	35-36 71-72	33-34 69-70	32	68				14			16					1	2	3	4	5	6	7	8	37	38	39	40	41	42	43	44	45	46	47	48	9	10	11	12	13	52	50	51	64	* 15	49	17	66	65		31 67			
	ACB2	2	35 71-72	34 70	32	68				14			36					1	2	3	4	5	6	7	8	37	38	39	40								41	9	10	11	12	13		42	43		* 15		16							
	ACB1	3	35 71-72	34 70	32	68				14			36					1	2	3	4	5	6	7	8	37	38	39	40								41	9	10	11	12	13		42	43		* 15		16							
	CSC	4	35-36 71-72	33-34 69-70	32	68	53	54	55	X 14			X 16	X 56	X 20			1	2	3	4	5	6	7	8	X 37	X 38	X 39	X 40	X 41	X 42	X 43	X 44	X 45	X 46	X 47	X 48	X 9	X 10	X 11	* 12	* 13	* 52	* 50	* 51	* 64	15	49	* 18	65	66	* 19	31 67			
RECEIVER SITE	RSC	5	35-36 71-72	33-34 69-70	32	68	53	54	55	17	X 14		X 16			X 56	X 20	1	2	3	4	5	6	7	8	X 37	X 38	X 39	X 40	X 41	X 42	X 43	X 44	X 45	X 46	X 47	X 48	X 9	X 10	X 11	* 12	* 13	* 52	* 50	* 51	* 64	15		* 18			* 19	31 67			
	IRB	6	35-36 71-72	33-34 69-70	32	68		54	55		14		16					1	2	3	4	5	6	7	8	37	38	39	40	41	42	43	44	45			48	9	10	11	12	13		50	51		* 15		52			53				
	RIB1	7	35-36 71-72	33-34 69-70	32	68					14		16					1	2	3	4	5	6	7	8	37	38	39			42			45									52	50	51											
	RIB2	8	35-36 71-72	33-34 69-70	32	68					14		16					1	2	3	4	5	6	7	8	37	38	39				43		45									52	50	51											
	RIB3	9	35-36 71-72	33-34 69-70	32	68					14		16					1	2	3	4	5	6	7	8	37	38	39					44	45									52	50	51											
TRANS-MITTER SITE	TSC	10	35-36 71-72	33-34 69-70	32	68	X 53	X 54	X 55	17		X 14	X 16					1	2	3	4	5	6	7	8	X 37	X 38	X 39	X 40	X 41	X 42	X 43	X 44	X 45	X 46	X 47	X 48	X 9	X 10	X 11	* 12	* 13	* 52	* 50	* 51	* 64	15		18			* 19	31 67			
	TIB1	11	35-36 71-72	33-34 69-70	32	68			11			9	10					1	2	3	4	5	6	7	8	37	38	39			40			41									44	42	43											
	TIB2	12	35-36 71-72	33-34 69-70	32	68			11			9	10					1	2	3	4	5	6	7	8	37	38	39				40		41									44	42	43											
	TIB3	13	35-36 71-72	33-34 69-70	32	68			11			9	10					1	2	3	4	5	6	7	8	37	38	39					40	41									44	42	43											
ALARM RELAYS	MAJOR IC PIN		13											9																																									1* 14	7 8
	MINOR IC PIN		13												9																																								1* 14	7 8
JUMPERS										3	3			1	2	1	2																																							
SOLDER PADS							SP 1X	SP 2X	SP 3X																																												SP 4*			

X INDICATES SIGNAL SOURCE.



MODULE EDGE CONNECTOR
(VIEWED FROM REAR
OF CARD CAGE BACKPLANE)

NOTES

1. INTER-SITE SIGNALS ARE COMMON TO ALL SITES. INTRA-SITE SIGNALS ARE UNIQUE WITHIN A SITE.
2. 600, WFI, AND 3600 CAN BE GENERATED BY THE TSC OR BY AN EXTERNAL SOURCE THRU SP1, SP2 AND SP3.
3. SIGNAL NAME REFERS TO THE FUNCTION ON THE SOURCE BOARD.
4. JU1 AND JU2 CONNECTED IN 2 SITE SYSTEM. (WITH RECEIVER SITE AND TRANSMITTER SITE ONLY).
5. MULTI-SOURCE SIGNALS.

DEPS-38811-0

rts list

016A 25' Control Cable Kit
017A 50' Control Cable Kit
018A 75' Control Cable Kit
019A 100' Control Cable Kit

PL-7595-B

EFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
	1-80712D30	ASSEMBLY, wire and lug; 25' (TKN8016A)
	or 1-80712D31	ASSEMBLY, wire and lug; 50' (TKN8017A)
	or 1-80712D32	ASSEMBLY, wire and lug; 75' (TKN8018A)
	or 1-80712D33	ASSEMBLY, wire and lug; 100' (TKN8019A)
		includes:
	10-10043A02	tie, wrap; 1/4"W; RED
	15-10759A03	HOUSING, connector; receptacle; 15 hole
	15-82486M02	HOUSING, cable support
	29-15119A41	LUG, crimp terminal; 8 used (see note 1)
	29-824151	LUG, slotted tongue; GND (see note 1)
	30-82669M01	CABLE, 6 twisted pairs; 300" TKN8016A; or 600" TKN8017A; or 900" TKN8018A; or 1200" TKN8019A
	37-9577	TUBING; #6 clear; 3-3/4" used (see note 1)
	37-134371	TUBING, heat shrink; 3/8" dia; BLK; 1" used (see note 1)
	37-82603D01	SLEEVING, coded number 1 (see notes 1 & 2)
	37-82603D06	SLEEVING, coded number 6 (see notes 1 & 2)
	37-82603d07	SLEEVING, coded number 7 (see notes 1 & 2)
	37-82603D10	SLEEVING, coded number 10 (see notes 1 & 2)
	37-82603D11	SLEEVING, coded number 11 (see notes 1 & 2)
	37-82603D13	SLEEVING, coded number 13 (see notes 1 & 2)
	37-82603D14	SLEEVING, coded number 14 (see notes 1 & 2)
	37-82603D15	SLEEVING, coded number 15 (see note 1 & 2)
	39-84257L01	CONTACT, pin; female; 12 used
	55-82511M01	LOCK, connector

s:

To facilitate shortening existing cable length (field modification), duplicate amounts of indicated items are included as a bag of loose parts with complete cable assembly.

Numbered sleevings on lugged ends of cable wires correspond to pins on plug-end of cable.

DESCRIPTION, INSTALLATION & MAINTENANCE

DESCRIPTION 68P81040E02
INSTALLATION 68P81066E58
SAFE HANDLING OF CMOS INTEGRATED CIRCUIT DEVICES..............68P81106E84
MAINTENANCE 68P81040E04

CARD CAGE CHASSIS

21-CHANNEL CARD CAGE CHASSIS 68P81046E94

MODULES

SITE CONTROLLER MODULES 68P81066E59
SITE CONTROLLER BOARD 68P81066E61
INBOUND RECOVER BOARD 68P81040E09
RECEIVER INTERFACE BOARD 68P81040E11
TRANSMITTER INTERFACE BOARD 68P81040E12
ASYNCHRONOUS COMMUNICATIONS BOARD 68P81125E55
SITE INTERFACE BOARD 68P81125E56
SITE AUDIO BOARD 68P81125E57

POWER SUPPLIES

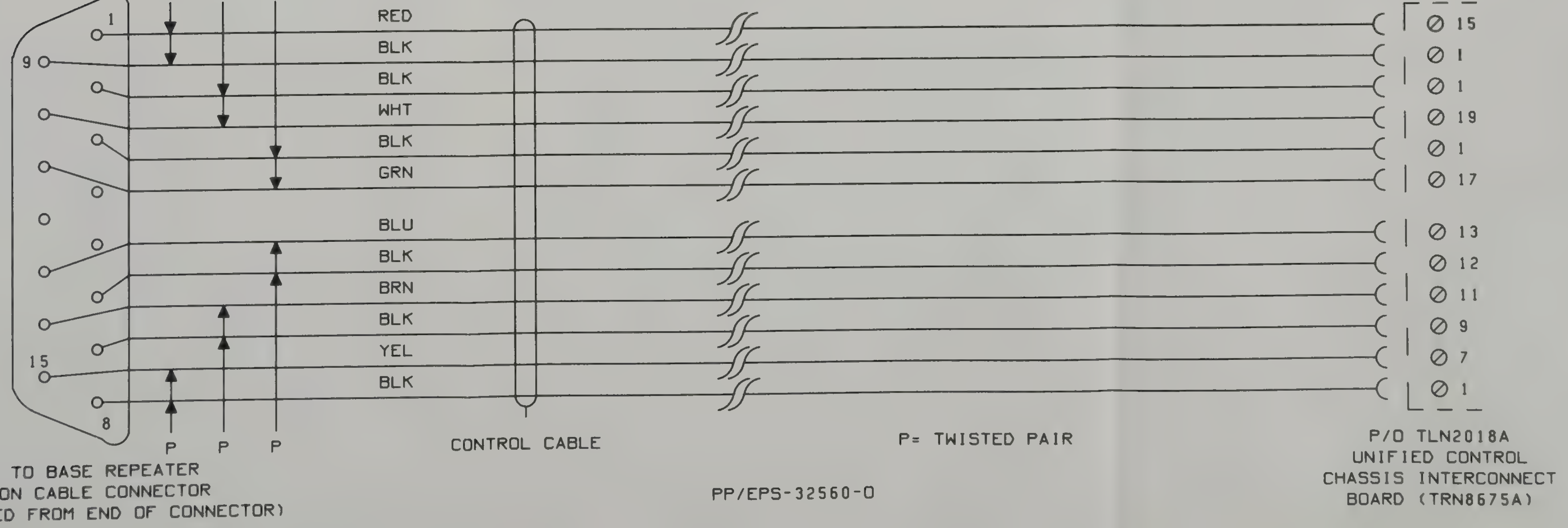
POWER SUPPLIES 68P81040E13

CENTRAL CONTROLLER TO BASE-REPEATER TRUNKED CONTROL CABLE DIAGRAM, CONNECTION CHART, AND PARTS LIST

TRUNKED CONTROL CABLE CONNECTION CHART

	TRANSMITTER SITE							RECEIVER SITE					
	TIB							RIB		RIB / IRB	RIB / IRB	IRB	
FUNCTIONS	TSTAT	TGND	TDATA+	TDATA-	$\overline{\text{PTT}}$	$\overline{\text{MUTE}}$	CONTROL CABLE SHIELDS	RSTAT	RGND	DISC	RGND	CCI	IGND
CONTROL CABLE PIN/WIRE#	15	8	14	7	6	13	4 EA.	1	9	10	2	11	3
BASE REPEATER TB3 CONNECTION	7	1	11	9	12	13	1	15	1	19	1	17	1
CONTROL CABLE WIRE COLOR	YEL	BLK (YEL)	BRN	BLK (BRN)	BLK (BLU)	BLU	4 BLK	RED	BLK (RED)	WHT	BLK (WHT)	GRN	BLK (GRN)
SERVICE INFORMATION	>3V= POWER 0V= NO POWER	—	TRANSMIT DATA+ DIGITAL SIGNAL	TRANSMIT DATA- DIGITAL SIGNAL	13.8V= NOT KEYED 0.75V= KEYED	HI= UNMUTE LO= MUTE PULSES HI 1MS EVERY 30 SEC. KEEPS BASE REPEATERS TRUNKED	TWISTED PAIR GROUND TIE POINT.	>3V= UNSQUELCH 0V= SQUELCH	—	RECEIVER DISCRIMINATOR	—	CONTROL CHANNEL INDICATOR	—

NOTE- CONTROL CABLE TWISTED PAIRS ARE IDENTIFIED BY COLOR. FOR EXAMPLE, THE YEL-BLK PAIR IS —YEL-BLK (YEL). THERE ARE SIX TWISTED PAIRS IN THE CONTROL CABLE—YEL-BLK (YEL), RED-BLK (RED), WHT-BLK (WHT), GRN-BLK (GRN), BRN-BLK (BRN), AND BLU-BLK (BLU). THE FIRST FOUR BLK LEADS ARE GROUND SHIELDS CONNECTED TO TB3-1. THE LAST TWO BLK LEADS ARE SIGNAL LEADS.



parts list

TKN8016A 25' Control Cable Kit
TKN8017A 50' Control Cable Kit
TKN8018A 75' Control Cable Kit
TKN8019A 100' Control Cable Kit

PL-7595-B

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	37-82603D10	SLEEVING, coded number 10 (see notes 1 & 2)
	37-82603D11	SLEEVING, coded number 11 (see notes 1 & 2)
	37-82603D13	SLEEVING, coded number 13 (see notes 1 & 2)
	37-82603D14	SLEEVING, coded number 14 (see notes 1 & 2)
	37-82603D15	SLEEVING, coded number 15 (see note 1 & 2)
	39-84257L01	CONTACT, pin; female; 12 used
	55-82511M01	LOCK, connector

notes:

1. To facilitate shortening existing cable length (field modification), duplicate amounts of indicated items are included as a bag of loose parts with complete cable assembly.
2. Numbered sleevings on lugged ends of cable wires correspond to pins on plug-end of cable

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SITE INTERFACE BOARD...68P81125E56
SITE AUDIO BOARD 68P81125E57

POWER SUPPLIES

POWER SUPPLIES 68P81040E13

MOTOROLA INC.
Communications
Sector

SITE CONTROLLER BOARD MODULES

IMPORTANT
THIS UNIT IS NOT CONSIDERED FIELD REPAIRABLE; IT SHOULD BE RETURNED TO A MOTOROLA SERVICE DEPOT FOR REPAIR.

1. MODEL COMPLEMENT

The Motorola Trunked Radio System Site Controller Board (SCB) modules are available in four configurations: Central Site Controller (CSC), Receiver Site Controller (RSC), Transmitter Site Controller (TSC), and Site Audio Board (SAB). Table 2 illustrates the model complement of these configurations.

2. DESCRIPTION

2.1 RECEIVER SITE CONTROLLER BOARD (RSC) MODULE

The RSC Module consists of a microprocessor unit with enough support circuitry to interface with the Inbound Recovery Board (IRB) module, the Receiver Interface Board(RIB) module(s), and the Central Site Controller (CSC) module. The control functions are found in the software (EPROM memory) associated with this board. The RSC communicates with the IRB and RIB modules via the address and data bus structure on the backplane interconnect board. The RSC communicates with the CSC module via a dedicated RS-232-C interface. The backplane also has other RS-232-C interfaces, which permit interface with peripheral equipment (such as a keyboard terminal) or to remote sites. The RSC contains power fail detect circuitry with automatic restart capability and includes provisions for both major and minor alarm detection and reporting.

The CSC has provisions for interfacing with a keyboard terminal. The System Manager Interface (SMI) provides greater flexibility in modifying system characteristics and interrogating current system status.

2.2 TRANSMITTER SITE CONTROLLER BOARD (TSC) MODULE

The TSC module consists of a microprocessor unit with enough support circuitry to interface with the Transmitter Interface Board (TIB) module and the CSC. The TSC communicates with the TIB module via the address and data bus structure on the backplane interconnect board. The TSC communicates with the CSC module via a dedicated RS–232–C interface. The TSC hardware is similar to the RSC hardware previously described. However,the TSC software package (contained in EPROM memory) is entirely different.

The major functions programmed into the TSC software-package include the generation of outbound data from the system control channel; the generation of subaudible data, which is superimposed on all voice channel communications; base repeater station control; rf power monitoring; generation of repeater station identification as required by the FCC; and maintenance of communication protocol between other modules and peripheral devices. The TSC is the source for all intersite clock signals.

2.3 CENTRAL SITE CONTROLLER BOARD(CSC) MODULE

The CSC module consists of a microprocessor unit with enough support circuitry to interface with the RSC, TSC, and the System Manager Terminal (SMT). The CSC communicates with the RSC module, TSC module, and SMT via dedicated RS–232–C interfaces on the backplane interconnect board. The CSC hardware is similar to the other site controllers previously described. The CSC's distinguishing characteristics result from the unique software package programmed into EPROM memory on the board. The CSC module accepts inputs from the RSC, decides upon the appropriate course of action, and tells the TSC what to do. The major functions of the CSC include call processing; call queuing; resource allocation; diagnostics; site–to–site protocol; and logging of usage statistics.

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technical writing services
1301 E. Algonquin Road, Schaumburg, IL 60196

2.4 SITE AUDIO BOARD (SAB) MODULE

The SAB module consists of a microprocessor unit with enough support circuitry to interface with the Data Concentrator Board (DCB) and the Site Interface Board (SIB). The SAB is a standard Central Site Controller Board. It is the same as the TRN9968A Site Controller Board except for additional software and firmware (see Table 2). In addition, the SAB has a unique jumpering configuration, as shown in Table 1.

The SAB interfaces with the Site Interface Board (SIB) and the DCB to report audio path status of the remote sites and the microwave. The SAB continuously tests a microwave audio path and generates a diagnostic message if a malfunction occurs. When the audio path is back in service, the SAB generates a diagnostic message to report the updated status. For detailed information on the SAB, refer to the Site Controller Board section, 68P81066E61, of the Trunked Radio System Central Controller Instruction Manual, 68P81066E60.

NOTE

> The SAB module is used in *Smartnet II* AMSS only.

Table 1. SAB Jumper Usage

Jumper Ref.	Position	Jumper Ref.	Position
JU1	Out	JU13	300
JU2	Out	JU14	4800
JU3	Out	JU15	4800
JU4	A	JU16	Upper
JU5	B	JU17	A
JU6	B	JU18	Out
JU7	B	JU19	B
JU8	B	JU20	Upper
JU9	A	JU21	Out
JU10	A	JU22	In*
JU11	B	JU23	A
JU12	B		

*Remove jumper JU22 when inserting static or dynamic RAMs or removing them from circuit.

Table 2. Site Controller Board Module Model Complement

MODEL COMPLEMENT CHART
for
TRUNKED RADIO SYSTEM
CENTRAL SITE CONTROLLER
EQUIPMENT

CODE

- ● = **One Item Supplied**
- 2 = **Number of Items Supplied**
- * = **Refer to Item Breakdown Chart**
- ** = **Refer to Site Controller Board Instruction Section for Further Details**

Description			*Privacy Plus–Enhanced* Central Controller	Automatic Multiple Site Switching (AMSS) Remote Spares	AMSS Master Spares	*Smartnet II* Code Plug Reprogramming	AMSS Trunked Remote Site	AMSS *Smartnet II* Master Central Site Controller	*Smartnet II* Simulcast/ *Spectra–TAC* Trunked Remote Site	*Smartnet II* Central Controller	*Privacy Plus* Type II Central Controller	*Smartnet* Central Controller	*Privacy Plus* Central Controller		
Model			T5255A	T5241A	T5240A	T5209A	T5187A	T5186A	T5185A	T5184A	T5152A	T5076A	T5004A		
														Item	Description
							●	2						BLN6731A	Punch Block
											●	●	●	TGN6124A	Blank Panels
			●								●		●	THN6377A	Cabinet and Hardware Kit *(Privacy Plus)*
							●	●	●	●		●		THN6629A	Cabinet and Hardware Kit *(Smartnet)*
			●				●	●	●	●	●	●	●	TKN8011A	AC Distribution Cable Kit
			●				●	●	●	●	●	●	●	TKN8012A	DC Distribution Cable Kit
							2							TKN8582A	AMSS ACB Cable Kit
								7						TKN8583A	AMSS SIB Cable Kit
								●						TKN8592A	AMSS ACB/SIB Cable Kit
								2						TKN8877A	2–Foot RS–232 Cable Kit
													●	TLN2866A*	CCU Cardcage and Modules
												●		TLN2934A*	CCU Cardcage and Modules
											●			TLN3013A*	CCU Cardcage and Modules (Type II)
			●	●	●		●	●		●				TLN3033A**	Type 2i Central Site Controller (CSC)
			●	●			●			●				TLN3035A**	Type 2i Transmitter Site Controller (TSC)
			●	●			●			●				TLN3036A**	Type 2i Receiver Site Controller (RSC)
									●					TLN3039A**	Type 2i Remote Site Controller (ReSC)
					●			●						TLN3040A**	Type 2i AMSS Data Concentrator Board (DCB)
					●			●						TLN3099A**	Site Audio Board (SAB)
			3				3	3	3	3	3	3	3	TPN6114A	5 Vdc Power Supply
			3				3	3	3	3	3	3	3	TPN6115A	12 Vdc Power Supply
				●	●		●							TRN7056A	Asynchronous Communications Board (ACB)
									●					TRN7068A	Remote Transmitter Interface Board (RTIB)
					●									TRN7124A	Site Interface Board (SIB)
			●	●			●		●	●				TRN8661A	Receiver Interface Board (RIB)
			●	●			●		●	●				TRN8662B	Inbound Recovery Board (IRB)
			●	●			●			●				TRN8663A	Transmitter Interface Board (TIB)
			●				●		●	●				TRN8664A	21–Channel Backplane Interconnect Board
			●				●		●	●				TRN8665A	Cardcage Hardware Kit
			●				●		●	●	●	●		TRN8693A	AC Power Distribution Box
			●			●	●	●	●	●	●	●	●	TRN9194A	System Information
			●	●	●	●	●	●		●				TVN6047A	Type 2i Codeplug Firmware

MAEPS–43301–B

MOTOROLA INC.
Communications
Sector

SITE CONTROLLER BOARDS
MODEL TRN9968A CSC/TSC BOARD AND MODEL TRN9815A RSC BOARD

1. INTRODUCTION

> **NOTE**
> The Site Controller Board (SCB) is configured as: the Central Site Controller (CSC); the Transmitter Site Controller (TSC); and the Receiver Site Controller (RSC).

1.1 The site controller board (SCB) is the intelligent controller of a trunking site. It contains a Motorola MC6809 Microprocessor (U21) complete with volatile, battery backed dynamic and static RAM, and non-volatile EPROM memory. Although the SCB generates site clocks for use in the site, the basic trunking timing clocks, however, can be externally generated for system synchronization.

1.2 Two dedicated RS-232-C ports for intersite communication and an RS-232-C port for system manager communication are provided on the board. Jumper placement allows selection of RS-232-C baud rates from 75 to 9600. However, data rates in excess of 4800 baud should not be used at the system manager's terminal.

2. MICROPROCESSOR
(Refer to schematic diagram PEPS-38816)

2.1 The microprocessor unit (MPU) is an MC6809 microprocessor (U21) with 16 address and 8 data lines. The input EXTAL (pin 38) is the external clock source for the MPU. The EXTAL frequency is divided by four to produce an internal clock signal (E) and a quadrature clock signal (Q). The E and Q clock output signals (pins 34 and 35) provide on board and site timing synchronization.

2.2 The MPU provides a bus available signal (BA) to indicate that the address, data, and R/_W lines are in the high impedance state. The BA signal is reset low during normal MPU program execution.

2.3 In addition the MPU has three interrupt service request inputs. The non-maskable interrupt, _NMI (pin 2), has the highest priority. _NMI is generated whenever an error is detected in the parity checker circuitry (see paragraph 9). The fast interrupt request signal, _FIRQ (pin 4), is generated whenever one of the ACIA's needs servicing. The interrupt request, _IRQ (pin 3), signal has the lowest priority of the three interrupts and is generated by the PIA U45. _FIRQ and _IRQ interupt signals may be generated or sent off board via the External Interrupt request signal, _XIRQ, through PAL, U30 pin 17. _FIRQ and _IRQ must be tied together by inserting jumper JU3 for proper RSC and TSC operation.

3. ADDRESS BUS (A0-A15)

3.1 Signals PAGE1, generated externally for redundant central operation (low for idle, high for active), and PAGE2, software set bit PA7 (Pin 9) of PIA U45, are used for handshaking in a multi-user environment. U28-5 buffers the PAGE1 input to PAL U30 and bit PA6 (pin 8) of PIA U45. PAGE2 inputs to PAL U30 and is sent off board through buffer U16. The valid memory address signal, (_VMA), is not used by the SCB but is pulled low and provided for external use. The direction of the address signal flow is determined by _ADIR, address direction, which is produced by PAL U30. Address line _XA15 is input and output through PAL U30.

3.2 The MPU connects to the internal site address bus (A0-A15) through transceivers U34 and U35, and buffers U68 and U56. Transceivers U22 and U23 link the internal site address bus to the common site address bus transceivers U1 and U2, and to the dynamic RAM address latches U9 and U10. PAL U30 resets the primary RAM enable signal, (_PRE), enabling transceivers U22 and U23. The direction of address signal flow is determined by _ADIR which is produced by PAL U30.

3.3 The internal site address bus inputs to several address decoders which form chip select signals for the PIA, ACIA's, static and dynamic RAM's, and EPROM's. Addresses A2, A3, A5-A8, and A11-A15 are gated through U65 and U77 and then input to PAL U30 and address decoder U64. PAL U30 generates the address decode signal (_ADEC), for off board use only.

The _ADEC line is reset low for addresses $8000-$87FF.

3.4 PIA chip select signal, _PCS, is a partial address decoder generated by U64 and used as the _CS2 input (pin 23) to PIA U45. The PIA inputs CS0 and CS1 (pins 22 and 24) are always selected since they are pulled high. A0 and A1 are used as the register select inputs, RS0 and RS1 (pins 36 and 35), resulting in PIA address locations $8000-$8003.

3.5 The ACIA chip selects, _ACS1 and _ACS2, are partial address decode signals generated by U64 and used as the _CS2 input (pin 9) of ACIA's U44, U42 and U43. Address line A1 inputs directly to CS0 and CS1 (pins 8 and 10) of ACIA2 (U44) and is inverted by U74 then input to CS0 and CS1 of ACIA1 (U43) and ACIA3 (U42). A0 is used as the register select input, RS (pin 11), resulting in ACIA1 address location $8100-$8101, ACIA2 address location $8102-$8103, and ACIA3 address location $8104-$8105.

3.6 When PAL U30 resets the primary RAM enable signal, _PRE, and sets the external enable signal _XEN, dynamic RAM is selected. Dynamic RAM is divided into two banks of 32k words each residing at address locations $0000-$7FFF. DRAM size is described in paragraph 8.5.

3.7 PAL U36 and address decoders U38 and U37 generate the Static RAM and EPROM control signals. Address signals A10-A15, and three page select lines, PAGE 1 (pin 4), PAGE 2 (pin 9), and PAGE 3 (pin 17) of PIA U45, are used to form partial address decode signals F1-F8 provided by PAL U36. Address decoder U37 provides either the address signal A11, to pin 18 of the selected EPROM or the chip enable signal, _CE (pin 18), of the selected static RAM. Address decoder U38 provides either the enable signal, _E (pin 20), to the selected EPROM or the output enable signal, _OE, to the selected static RAM. The EPROM and the static RAM's use address lines A0-A9 directly, and the EPROMs use addresses A10-A12 gated through U36 and U37 to select an internal address location. The EPROM page addressing scheme is described in paragraph 8.

3.8 The following are static RAM and EPROM memory locations present on the central site controller board (CSC).

Table 1. Memory Locations for TLN2997A CSC

U49	RAM locations $9000-$97FF
U48	EPROM locations $A000-$BFFF
U47	EPROM locations $C000-$DFFF; PAGE 0
U46	EPROM locations $E000-$FFFF; PAGE 0
U60	EPROM locations $C000-$DFFF; PAGE 1
U59	EPROM locations $E000-$FFFF; PAGE 1
U58	EPROM locations $C000-$DFFF; PAGE 2
U57	EPROM locations $E000-$FFFF; PAGE 2

Table 2. Memory Locations for
TLN3006A CSC
TLN3011A CSC
TLN3033A CSC

U49	RAM locations $9000-$97FF
U48	EPROM locations $A000-$A3FF
U47	EPROM locations $A400-$FFFF
U46	EPROM locations $A400-$FFFF
U60	EPROM locations $A400-$FFFF
U59	EPROM locations $A400-$FFFF
U58	EPROM locations $A400-$FFFF
U57	EPROM locations $A400-$FFFF

Table 3. Memory Locations for
TLN3001A RSC
TLN3036A RSC

	Receiver Site Controller Board
U49	RAM locations $A000-$A7FF
U48	Not Used
U47	Not Used
U46	Not Used
U60	Not Used
U59	Not Used
U58	Not Used
U57	EPROM locations $E000-$FFFF

Table 4. Memory Locations for
TLN3000A TSC
TLN3012A TSC
TLN3035A TSC

	Transmitter Site Controller Board (TSC)
U49	RAM locations $9000-$97FF
U48	Not Used
U47	Not Used
U46	Not Used
U60	Not Used
U59	Not Used
U58	Not Used
U57	EPROM locations $E000-$FFFF

Since the ACIA's and PIA addresses are only partially decoded, the ACIA's and PIA are selected and enabled for addresses other than those mentioned above.

4. DATA BUS (D0-D7)

4.1 The SCB module connects to the common site data bus via three-state transceiver U3, when the external enble signal, _XEN, is reset by PAL U30. The common data bus is pulled high such that the absence of an off board addressed unit results in a $00 response. If the primary RAM enable signal, _PRE, is reset by PAL U30, transceiver U32 connects the internal site data bus either to dynamic RAM or to the common site data bus through transceiver U3. The address direction signal, _ADIR and the R/_W signal are fed into an EXCLUSIVE-OR gate (U73) to form RAM direction, RDIR. RDIR is input to U32 and U3 (pin 1) to enable data flow in the proper direction for an on-board or off-board, read or write function.

4.2 Transceiver U33 connects the MPU to the internal site data bus. The internal site data bus connections for the EPROM, static RAM's, ACIA's and the PIA are hard-wired together. Proper addressing is relied upon to prevent bus contention. Since the ACIA and the PIA addresses are only partially decoded, their data output may be enabled for addresses other than the specific location mentioned above.

4.3 The internal site data bus is terminated by pull up resistors (R1 through R8) to +5 V. In the absence of an addressed device the reading of the integrated circuit location results in the data byte $00 being presented to the MPU.

5. MASTER OSCILLATOR/ INTRASITE CLOCK

5.1 A 15.840 MHz temperature compensated crystal oscillator (U14) is the master oscillator for the board and the source of all intrasite clocks. Counter U25 provides a divide-by-2 (7.9200 MHz) and divide-by-4 (3.9600 MHz) output that is jumper selectable (JU19) for input to the EXTAL input of the MPU. The 7.9200 MHz output (JU19 A) is used for fast site controller board applications; the 3.9600 MHz output (JU19 B) is used for all other applications. Counter U13 provides a divide-by-5 (3.168 MHz) output for input into U27-2 of the CLOCK GENERATOR circuit.

5.2 The MPU divides the EXTAL input (U21-38) by four to generate processor clocks E (U21-34) and Q (U21-35). U16-8 and U16-13 buffer the E clock to provide E and _E and U16-11 buffers the _Q clock to provide Q for IC timing on the SCB. The E and Q clocks are buffered by U15 for external use when jumper JU1 is out. If jumper JU1 is inserted, the E and Q clocks are input from an external source through buffer U15.

5.3 The 3.168 MHz clock (from U13-2) is supplied to a divide-by-11 counter (U27) to generate a 288 kHz clock which U54-1 buffers for external use. The 288 kHz signal is also fed into U26, a divide-by-16 counter, then into U81, a divide-by-5 counter, to generate a 3600 Hz clock. U69 divides 3600 Hz by 6 to provide a 600 Hz signal. U71 divides the 600 Hz clock by 15 to produce 40 Hz CLOCK. 40 Hz is divided by two through U81 to provide 20 Hz CLOCK use in the watchdog timer circuitry. 40 Hz is also routed to the PIA CB1 input (U45-18) as an interrupt-driven timing signal. The 600 Hz clock from U69-15 is also input to U70, a divide-by-14 counter, to produce WFI (42.86 Hz Word Frame Interrupt).

6. INTERSITE CLOCKS (3600 Hz, 600 Hz, AND WFI)

6.1 Coordination of ISW-OSW timing requires synchronization of the 3600 Hz, 600 Hz, and WFI clocks between sites. The 3600 Hz clock is generated by U81. The output of U81-12 is sent to inverting three-state transceiver U29-7 for external use. The 3600 Hz clock is also routed through U29 to the CB2 input, (pin 19), of PIA U45 for use by the MPU as an interrupt-driven timing signal. The 600 Hz clock is generated by U69. The output of U69-15 is sent to inverting three-state transceiver U29-3 for external use. The 600 Hz clock is also routed through U29-2 to the CA2 input (pin 39) of PIA U45 for use as an interrupt-driven signal. The WFI clock, 42.857 Hz, is generated by U70. The output of U70-15 is sent to inverting three-state transceiver U29-13 for external use. The WFI clock is also routed through U29-14 to the CA1 input (pin 40) of PIA U45 for use as an interrupt-driven signal.

6.2 Only one SCB board, the Transmitter Site Controller board (TSC), generates intersite clocks for boards on a common bus. When jumper JU2 is removed from the TSC, the input to U29-15 is pulled high, which enables the drivers of U29 to output the signals to the bus. In addition, the clock signals are connected to the inputs of PIA U45 on the clock source SCB.

6.3 Jumper JU2 is inserted in the SCB modules, Receiver Site Controller (RSC) and Central Site Controller (CSC), which are designated as intersite clock receivers. This disables the drivers of transceiver U29 and isolates the PIA from the on-board clock sources (U81, U69 and U70). The _3600 Hz, _600 Hz, and _WFI clocks enter the board and are routed to the PIA U45 through receivers on U29.

7. ASYNCHRONOUS COMMUNICATION INTERFACE ADAPTER (ACIA)

7.1 Communication between sites is achieved by means of an RS-232-C link. Provision has been made on the site backplane for cable or modem interconnection if the sites are not co-located. For co-located sites, a null modem is built into the site backplane to make communication possible without using an RS-232-C cable. Communication with the TSC from the CSC is achieved through ACIA3 (U42 at location $8104-$8105). ACIA3 drives U51-8-RTS3 and U50-11-TXD3 and monitors U41-1-CTS3, U41-6-RXD3, and U41-8-DCD3. Communication with the RSC from the CSC is achieved through ACIA2 (U44 at locations $8102-$8103). ACIA2 drives U51-11-RTS2 and U51-6-TDX2 and monitors U41-11-CTS2, U39-6-RXD2, and U40-8-DCD2. Communication between the TSC and the RSC is achieved through ACIA2 on the TSC (U44) and ACIA3 on the RSC (U42). Communication with a user terminal from the CSC, RSC, or TSC is achieved through ACIA1 (U43 at locations $8100-$8101). ACIA1 drives U50-3-RTS1 and U50-6-TXD1 and monitors U40-3-CTS1, U40-11-RXD1, and U40-6-DCD1. The user terminal can be connected to the CSC, RSC, or TSC terminal connector on the backplane as described in the System Manager's Operating Manual 68P81065E15.

7.2 Receivers U39, U41, and U40 are used to detect the clear to send, CTS, signal. The CTS signal may be used to determine if an asynchronous communication device is attached to the serial port. In the absence of an asynchronous communication device, the infinite impedance of the response control resistor sets the output of a receiver high. The CTS signal input to the ACIA is inactive. If an asychronous communication device is present, an input voltage greater than 1.5 V resets the output of the receiver low. In this case an active CTS signal is presented to the ACIA.

7.3 The baud rate at which the ACIA's transmit and receive data is jumper-selectable from a matrix of rates generated by baud generator U82. A selected baud rate is buffered by U67-2 for ACIA1, U56-4 for ACIA2, and U56-2 for ACIA3. The following baud rates are available:

Table 5. Baud Rates

75 baud	1.2 kHz
110 baud	1.76 kHz
300 baud	4.8 kHz
600 baud	9.6 kHz
1200 baud	19.2 kHz
1800 baud	28.8 kHz
2400 baud	38.4 kHz
3600 baud	57.6 kHz
4800 baud	76.8 kHz

The following baud rates are also available, **but not recommended**, for use. If used, these rates may produce communication errors.

7200 baud	115.2 kHz
9600 baud	153.6 kHz

The frequency of each rate is 16 times the associated baud rate (e.g., 75 baud = 1200 Hz).

8. MEMORY (RAM and EPROM)

8.1 Memory on a SCB module consists of non-volatile EPROM, static RAM, and dynamic RAM. The A0-A9 inputs are directly connected to the internal site address bus. Addresses A10-A12 are routed from the internal site address bus through PAL U36 and address decoder U37. The D0-D7 outputs are directly connected to the internal site data bus.

8.2 EPROM chip enable is determined by the programmed PAL U36 and address decoder U38. The PAL uses address lines A11-A15 from the internal site address bus and 3 software set page bit PA3 (pin 5), PB7 (pin 17) and PA7 (pin 9) of PIA U45, for EPROM chip select. EPROM memory address space is reused by means of a page addressing scheme. The EPROM's that reside in IC sockets can be divided into 7 separate pages, each page may overlap memory address locations. The page to be selected is software controlled by setting page bit PA3 (pin 5), PA7 (pin 9), and PB7 (pin 17) of PIA U45. At present, this allows 200k of addressable EPROM memory to effectively use as little as 24k memory address locations. The E and Q clock signals are also used by the address decoder (U38) to enable EPROM data onto the internal site data bus.

8.3 A maximum of eight 8k × 8 bit static RAMs can be used on a SCB module. However, there can only be a total of eight EPROM and RAM chips on one board (U46-U49 and U57-U60). The A0-A9 inputs are routed directly to static RAM from the internal site address bus. The D0-D7 bidirectional lines are connected directly to the internal site data bus. The control input, R/ __W, is sent through PAL U36 and the output enable signal, OE, is controlled by PAL U36 and address decoder U38.

8.4 The static RAM in socket U49 is provided with a battery back-up power source that preserves the variable system parameters if the +5 V source fails. The static RAM chip enable signal, F1, of U49 is set high by __PFD through Q4 when under battery back-up.

8.5 The SCB memory locations $0000-$7FFF address nine one meg × 1 bit dynamic RAM chips. Eight DRAMs combine to form an 8-bit word and the ninth chip is used to hold a parity bit. The DRAM is jumper selectable by JU18 to be two 32K pages (for all *SMARTNET* type I and *Privacy Plus* applications) or thirty-two 32K pages (for *SMARTNET* type II CSC). The page addressed in the two-page mode is selected by software controlled signal DRPGO. DRPGO is controlled by setting PB1 (pin 11) of PIA U45. The page addressed in the 32-page (1 Meg) mode is selected by writing the page number desired to DRAM page latch U83 at location $800C.

8.6 The A0-A14 address signals are routed through latches U9 and U10 and either buffers U22 and U23 from the internal site address bus or through buffers U1 and U2 from the common site address bus. The bidirectional data signal is sent either through buffer U32 to the internal site data bus or through buffer U3 to the common site data bus. During a memory cycle for two-page (64K) operation, high address byte A10-A14 and DRPGO are latched into the DRAM on the negative edge of the row address strobe, RAS. The low address byte (A0-A9) is latched into the DRAM on the negative edge of the column address strobe, CAS. During a memory cycle for 32-page (1 Meg) operation, high address byte A10-A14 and D1, D2, D3, D4, and D5 of page latch U83, are latched into the DRAM on the negative edge of the row address strobe, RAS. The low address byte (A0-A9) is latched into the DRAM on the negative edge of the column address strobe, CAS. A memory cycle is initiated when on-board DRAM is selected by PAL U30. __XRAM, a software controlled signal, determines whether external or on-board DRAM is being addressed. __XRAM is controlled by setting PA5 (pin 7) of PIA U45 high. XE, external enable, is set high and __PRE, primary RAM enable, is reset low by PAL U30. This turns the refresh circuitry (U11) off and multiplexes in the 20 address lines from U9 and U10. The row address strobe comes from the __E.SYNC clock present at U24-13. The DRAM (U4-U8 and U17-U20) and its refresh circuitry (U14, U25, U24, U73, U76, U74, U72, U11, and U12) are completely battery backed. Binary counter U12 and latch U72 via latch U11 select each address row to refresh the DRAMs when the DRAMs are not being accessed or if the +5 V dc power source fails. The +5 V comparator U52 is also battery backed.

8.7 All dynamic RAM chips are provided with a battery back-up power source that preserves the variable system parameters if the +5 V power source fails. When dynamic RAM is operating under battery back-up power, the power failure detect signal, __PFD, turns off transistor Q3 which causes __CAS to be set high through pull-up resistor R131.

9. PARITY CHECKER

9.1 The SCB module employs a parity bit associated with each word which is used to detect when an error has occurred in reading dynamic RAM. On a write to dynamic RAM, the parity bit data output (U17-1) is at high impedance. Pull-up resistor R37 sets the parity bit input high to parity generator U31. The odd sum parity, U31-6, is written into the parity bit dynamic RAM U17. The parity checker latch, U63, is not clocked on a write. This keeps __NMI, the parity error interrupt signal set high.

9.2 On a read from dynamic RAM, all eight bits of the addressed word plus the parity bit are input to the parity checker U31. The odd parity output U31-6, is clocked into the parity checker latch U63. This input is latched on the positive edge of __CAS which is sent through gates U78-8 and U75-9. If there is a parity error, the output of U63-5 goes low enabling the __NMI interrupt through buffers U28-3 and U28-1. Buffer U28-3 supplies the __NMI signal for external use as __XNMI.

9.3 The __NMI signal is set high by reading from, or writing to, address $8004. The address decoder U25 selects the __NMIP output (pin 14) and pulls it low. __NMIP, when active, sets the parity checker latch, U63-4, which turns off __NMI.

10. POWER FAILURE DETECT (__PFD)

10.1 The __PFD comparator, U52, senses a linearized temperature-compensated resistor network (RT2, R118, R124, R123, R126, R127) and compares the divider voltage with a Zener reference voltage from VR1. When Vcc = 4.62 V (±0.12 V), the divider voltage is greater than the Zener reference, resulting in a high impedance output both at U52-2 and U52-13. As Vcc falls below 4.62 V, the divider voltage falls below the Zener reference voltage and U52-2 goes to a low impedance to ground state (open collector), discharging C8 through current-limiting resistor R111. As the input voltages to U52-11 falls below 4.62 V, U52-13 goes to a low impedance to ground state discharging C9 through current-limiting resistor R120. When C9 is fully discharged, the __PFD signal is active at 0 V. When power is restored and Vcc rises above 4.62 V the divider voltage rises above the Zener reference and U52-13 goes to a high impedance state. When this occurs, C8 charges through R112 and C9 charges through R122 as the input voltage to U52-11 rises above 4.62 V. This delays the transition of __PFD from low to high voltage to allow an orderly power up of the MPU. The __PFD transition must also be delayed for power-up of dynamic RAM if battery backed power was lost.

10.2 __PFD protects the battery backed dynamic RAM and holds the MPU in the reset state while the +5 V supply is out of regulation. In addition, the rising __PFD signal provides the first trigger pulse for the run "tickle" circuitry U80-10 and, through U76-1, resets the MAJOR and MINOR alarms. When +5 V operation returns, U80-1 debounces the rising edge of __PFD to provide a clean, final reset pulse to the MPU (a minimum pulse of 940 ±100 microseconds).

11. BATTERY BACKUP CHARGER

11.1 While Vcc is greater than 4.62 V dc (nominal), current for all the VB+ supplied components flows through diode CR2. Transistor Q7 is off, isolating batteries BT1 and BT2 from the power back up components. The batteries receive charging current from the +12 V power supply through diode CR3 and current limiting resistors R110 and RT1. The batteries can supply 4.8 V for 40 minutes when fully charged. The site must be powered up for 48 hours for the batteries to be fully charged.

11.2 If Vcc is less than 4.62 V dc, current for all the VB+ supplied components flows through transistor Q1. Power failure detect, __PFD, goes low when Vcc drops below 4.62 V (see paragraph 10) turning on Q7 and turning Q6 off. When __PFD is less than 2.4 V DC, the volt supplied to the base of transistor Q1 is greater than the emitter voltage turning on Q1. Back up power may also be externally supplied. External back up power is input at edge connector pins 31 and 67, and passes through diode CR1.

11.3 Battery back up jumper JU22 (JUVB+) should be removed before inserting or removing a B+ supplied component. This removes power from all battery backed up devices.

12. WATCHDOG TIMER ("TICKLE")

12.1 The watchdog timer, or "tickle" circuit, insures that the MPU does not remain in a software-error condition. Failure to properly "tickle" the watchdog timer causes an MPU reset. The MPU generates a "tickle" pulse by toggling the PB0 output (pin 10) of PIA U45. The "tickle" is buffered by U56-13 and is detected by input A (pin 9) of retriggerable monostable U80-9. The monostable holds the Q output high for 150 milliseconds after each negative transition on the A input. The Q output keeps the RUN indicator on, and the A input of U80-1 constantly low provided "tickle" pulses are received. The _Q output of U80-4 is a stable high which causes the _RESET to be inactive. If a "tickle" pulse is not generated within the 150 millisecond time-out period the Q output of U80 goes low. This turns off the RUN indicator, sets the MAJOR ALARM latch U66, and turns on the site FAILURE indicator via gates U78-11, U53-2 and driver U61-6. A low output from U80-5 also enables U79 which passes the 20 Hz, 50 millisecond clock pulses, to the A input of U80. This generates a reset pulse that is passed to the MPU and PIA.

12.2 The initial "tickle" pulse on power-up is provided by _PFD to input B (pin 10) of U80. After the power-up pulse, and between successive "tickle" pulses, U80 sets the time-out at 150 milliseconds. If a timeout occurs, there is a 0-50 microsecond window in which the MPU reset pulse may be cancelled if a "tickle" pulse arrives at input A of U80 before a positive transition of the 20 Hz clock arrives at U79.

13. RESET

13.1 Reset can be internally or externally generated for the MPU and PIA. A hardware _RESET can be generated by operating the front-panel RESET pushbutton. Pressing the front-panel RESET pushbutton (switch S2 enabled by key switch S6) sets the output of NAND gate U76-1. The high input to NOR gate U55-2 activates the _RESET signal of the MPU input U21-37 and at the PIA input U45-34.

13.2 The watchdog timer circuitry generates a software _RESET pulse if the output of the monostable multivibrator U80 is reset low, setting the output of NAND gate U76-1 high. This in turn activates the _RESET line to both the MPU and PIA.

13.3 A power failure _RESET occurs when _PFD is low. Again a low _PFD signal causes the output of U76-1 to be set. The _RESET line of the MPU and the PIA will be held low as long as _PFD is low.

13.4 _RST0 and _RST1 are intersite reset signals. If jumper JU1 is in, _RST0 becomes an input signal and _RST1 is disabled. When jumper JU1 is removed, _RST0 becomes an output signal and _RST1 is an input signal. For normal system operation, jumper JU1 is removed from the CSC, RSC and TSC boards. A reset of the CSC board resets the MPU and PIA of the CSC, RSC, and TSC boards (refer to 21-channel card cage chassis). A reset generated on the RSC board resets the MPU and PIA of the RSC, IRB, and RIB boards. A reset on the TSC board resets the MPU and PIA of the TSC and the TIB boards.

14. MAJOR and MINOR ALARMS

14.1 The MAJOR ALARM D flip-flop (U66) is set by a software run failure from U80 via U77-8 (refer to the WATCHDOG TIMER circuitry). U77-9 can also be set by software command by pulling the PB5 output (pin 15) of PIA U45 low. The PIA output is also routed through U77-8. The MINOR ALARM D flip-flop (U63) can be set by software command, by pulling the PB6 output (pin 16) of PIA U45 low. This PIA output is buffered by U67.

14.2 The MAJOR and MINOR ALARM signals are output by dry-contact relays in the site backplane. The relay control signals are high during normal operating conditions, and low during an alarm condition. When an alarm condition occurs, the MAJOR or MINOR ALARM signal is presented to an input of U62-9 or U62-5, respectively. If the ALARM CUTOFF button is depressed, the outputs of U62-8 and U62-6 remains high. Otherwise, open collector buffer U28-10 (MAJOR) or open collector buffer U28-8 (MINOR) outputs an active low signal to the ALARM relays.

14.3 The relays can be tested by depressing the INDICATOR TEST push button on the front panel. The ALARM CUTOFF button cannot be depressed while testing the ALARM relays. The INDICATOR TEST signal and ALARM signals are input to U62-10 and U62-4. These outputs and the ALARM CUTOFF signal are fed into U62-13 and U62-2 and presented to the relays through open-collector buffers U28-10 and U28-8.

14.4 After an alarm condition occurs, the alarm may be deactivated by depressing the ALARM CUTOFF switch (the ALARM CUTOFF LED will turn on). This stops all alarm indications but does not reset the MAJOR ALARM and MINOR ALARM flip-flops (U66 and U63). The flip-flops may be reset by a return to power condition (from power failure) or by turning the SERVICE ENABLE key switch (S6) from the RUN to the service position.

15. FRONT PANEL SWITCHES (DISABLE, RESET, TEST, INDICATOR TEST, ALARM CUTOFF PUSHBUTTONS; SERVICE ENABLE KEY SWITCH)

15.1 The SERVICE ENABLE key switch (S6) enables the TEST, RESET, and DISABLE pushbuttons by providing ground for these pushbuttons. The SERVICE ENABLE switch, which is read by PA0 input (pin 2) of PIA U45, resets the MAJOR and MINOR ALARM flip-flops when turned to the SERVICE position. During normal system operation, the SERVICE ENABLE switch is in the RUN position, and the PA0 input is high indicating the RUN mode.

15.2 The DISABLE pushbutton, a push-on/off switch (S1), is read by the PA2 input (pin 4) of PIA U45. This input is normally high indicating that the board is enabled.

15.3 The RESET pushbutton (S2) is a momentary switch that forces the output of NAND gate U67-11 to go high. This signal input to NOR gate U78 resulting in a low output. This causes a hardware reset of the MPU and PIA. It also toggles the board RST0 output (external pin 14) low.

15.4 The TEST pushbutton (S3) is a momentary switch that is read by the PA1 input (pin 3) of the PIA U45. This input is normally high indicating that no self-test is requested.

15.5 The INDICATOR TEST pushbutton (S4) is a momentary switch that turns on all the LED and alarm indicators located on a common system backplane. All indicators are activated by this switch. This switch is buffered by U68 for use on board and is routed directly to external pin 16 as a _LAMPTEST signal (normally high) to the backplane. U68-2 output is routed to drivers U61-9, U61-3, U61-11 and U61-5 and is buffered by U67-17 to activate the alarms via U62-10 and U62-4. The ALARM CUTOFF indicator is activated directly by this switch.

15.6 The ALARM CUTOFF switch (S5) is a push-on/push-off switch that is read by the PIA PA4 input (pin 6) of PIA U45. When on, it disables the major and minor alarm gates (U62-13 and U62-1), preventing the relay drivers (U28-11 and U28-9) from operating. The ALARM CUTOFF signal is normally high to permit operation of the alarm. By depressing the ALARM CUTOFF switch before operating the INDICATOR TEST pushbutton, a service technician can test the system light indicators without setting off the alarms. Once an alarm condition is acknowledged and in the process of being serviced, the ALARM CUTOFF switch can be depressed to deactivate the alarm relay. This switch must be returned to the off (raised) position after service is completed.

15.7 Jumper JU4 can be used to disable the front panel indicator test from working unless the service enable key switch is in the service enable position. This is to prevent unauthorized personnel from pressing the indicator test pushbutton and causing the major and minor alarms to switch on.

16. FRONT PANEL INDICATORS (RUN DISABLED, ACTIVE, FAILURE, ALARM CUTOFF)

16.1 The RUN indicator controlled by the "tickle" circuitry via driver U61-10, indicates that the program is operating properly. The DISABLED indicator controlled by the PIA PB2 output (U45-12) via buffer U56-3 and driver U61-2, indicates the SCB is waiting to establish RS-232 communications with the CSC. The ACTIVE indicator controlled by the PIA PB3 output (U45-13) via buffer U56-15 and driver U61-13, acknowledges that the TEST switch has been read and acted upon.

16.2 The site FAILURE indicator is controlled either by:

- the PIA PB4 output (U45-14) via gate U53-1, or
- by the MINOR ALARM signal (U63-9) via gates U78 and U53, or
- by the MAJOR ALARM signal (U66-9) via gates U78-11 and U53 to driver U61-6.

16.3 The ALARM CUTOFF indicator is controlled by the ALARM CUTOFF switch (S5) to indicate that the alarm circuitry cannot activate the alarm relays.

16.4 All indicators can be turned on by depressing the INDICATOR TEST switch.

SITE CONTROLLER BOARDS
PARTS LISTS

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
U79	5184118K13	quad 2-input NOR gate
U80	5184084D27	dual monostable multivibrator
U81	5184118K47	presettable decade counter
U82	5182807K14	bit-rate generator
U83	5184118K56	octal D flip-flop w/3-state output
		voltage regulator: (see note)
VR1	4883461E17	Zener: 2.5 V
		crystal:
Y1	4883853F02	1.843 MHz
	non-referenced items	
	0300134184	SCREW, lock: 4-40 × 5/16; 3 used
	0400129021	LOCKWASHER: 3/4 internal
	0982808R05	SOCKET, 18-contact: for U4-U8, U17-U20
	0982808R06	SOCKET, 20-contact: for U30, U36
	0982808R10	SOCKET, 28-contact: for U46-U49, U57-U60
	0984181L01	CONNECTOR, 2-contact jumper; 21 used
	0984728L01	SOCKET, connector: 2-contact
	1484583B02	INSULATOR: for Y1
	1484891E02	INSULATOR, standoff switch; 10 used
	3884683F01	PUSHBUTTON; 5 used
	4184891F01	SPRING
	4284837F01	CLIP
	5483865R01	LABEL, bar code
	5582239K01	LATCH
	6184989F01	WINDOW, ID
	6484680F15	PANEL, front

TRN7046A *SMARTNET II* TCi/DCB PAL PL-11130-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		integrated circuit: (see note)
U57	5190043C87	programmed IC

TVN6052A *SMARTNET II* DCB Software PL-11127-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		integrated circuit: (see note)
U57	5190043C90	programmed IC

TVN6053A *SMARTNET II* ReSC Software PL-11128-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		integrated circuit: (see note)
U57	5190043C87	programmed IC

note: For optimum performance, diodes, transistors, and integrated circuits must be ordered by Motorola part numbers.

TRN7047A *SMARTNET II* CSC PAL PL-11387-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
U57	5184061P14	programmed PAL

TRN7048A RSC/RESC Type II PAL PL-11388-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
U57	5184061P13	programmed PAL

TRN7049A 6 Page PAL CSC PL-11389-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
U57	5184061P11	programmed PAL

DESCRIPTION

100k
2100 ±0.5%
1500
10
1000
2400
2100 ±0.5%
750 ±0.5%
1000
215 ±1% 1/2 W
2100 ±0.5%
1000
10k
1500
1000
39k
1000
2200
1000
1 meg
33k
10k
4700
100k
47k
22
510
10k
510
10k
75
180
390
3300
390
22
10k
3300
120
150
3300
10k
1000

thermistor:
2.030 ohms @ 25° C

switch:
pushbutton: 2-pole; P-P
pushbutton: 2-pole; M
pushbutton: 2-pole; P-P
switch, lock: spst

integrated circuit: (see note)
transceiver octal bus inverter
latch
9-bit transparent latch
dual 4-bit binary counter
presettable decade counter
15.84 MHz oscillator
quad bus 3-state driver/receiver
octal buffer line driver
8-bit microprocessor
bus transceiver
quad 2-input NOR gate
dual 4-bit binary counter
synchronous binary 4-bit counter
hex buffer driver
quad bus 3-state driver/receiver
9-bit odd/even parity generator/checker
bus transceiver
octal buffer line driver
1-of-8 decoder/demultiplexer
quad receiver DTL line
1.5 MHz ACIA
PIA
TTL/DTL-to-MOS line driver
comparator
quad 2-input NAND gate
hex bus receiver
quad 2-input NOR gate
octal buffer line driver
quad 2-input positive NOR buffer
quad 2-input NAND gate
dual D edge trigger flip-flop
1-of-8 decoder/demultiplexer
triple 3-input NOR gate
dual D edge trigger flip-flop
octal buffer line driver
hex inverter
synchronous binary 4-bit counter
dual D edge trigger flip-flop
quad exclusive OR gate
hex inverter
quad 2-input NAND gate
quad 2-input NAND gate
quad 2-input NAND gate
quad 2-input NOR gate

REFERENCE SYMBOL

TRN9306B Recei
REFERENCE SYMBOL
U30

TRN5726B Centr
REFERENCE SYMBOL
U30

TRN9309A TSC S
REFERENCE SYMBOL
U57

TRN5727A TSC 6
REFERENCE SYMBOL
U36

TRN9995A Static
REFERENCE SYMBOL

TRN9996A Dynar
REFERENCE SYMBOL
U4 thru 8
U17 thru 20

TVN6046A *SMAR*
REFERENCE SYMBOL
U46
U47
U57
U58
U59
U60

TVN6047A *SMAR*
REFERENCE SYMBOL
U48

TVN6049A *SMAR*
REFERENCE SYMBOL
U57

TVN6050A *SMAR*
REFERENCE SYMBOL
U57

TVN6051A *SMAR*
REFERENCE SYMBOL
U57

sed
d

parts list

TRN9725A Module Master Control
TRN9815A Module Master Control TSC RSC
TRN9890A Module Master Control PL-9990-D

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		battery:
BT1, 2	60-84542P01	nickel, cadulum; 2.4 V
		capacitor, fixed; uF: unless otherwise stated
C1	21-82213E17	470 pF ±10%; 100 V
C2, 3	21-84448K03	0.1 +80-20%; 50 V
C4	21-82213E10	240 pF
C5	21-82187B11	1500 pF ±10%
C6, 7, 8	21-84426B33	330 pF ±5%; 500 V
C9, 10	23-84669A25	15 +150-10%; 25 V
C11, 12, 13	21-84426B33	330 pF ±5%; 500 V
C14, 15	8-11044A28	0.15 ±5%; 50 V
C16	23-84669A19	100 +150-10%; 20 V
C17, 18	23-84669A25	15 +150-10%; 20 V
C19	23-84538G03	0.1 ±20%; 35 V
C20	21-82187B16	3000 pF ±10%; 100 V
C21	8-82317B01	0.1 ±10%; 100 V
C22	23-84669A25	15 +150-10%; 25 V
C23	21-84448K03	0.1 +80-20%; 50 V
C24 thru 90	8-11044A28	0.15 ±5%; 50 V
C91	21-11031A28	36 pF ±5%
C92	20-82089R05	40 pF Variable
		diode: (see note)
CR1, 2	48-82525G23	silicon
CR3	48-83654H01	silicon
CR4	48-82466H13	silicon
CR7	48-84616A01	hot carrier
CR8	48-82466H13	silicon
CR9, 10	48-83654H01	silicon
		light emitting diode: (see note)
DS1	48-88245C18	GRN
DS2	48-88245C17	RED
DS3	48-88245C19	AMBER
DS4	48-88245C17	RED
DS5	48-88245C19	AMBER
		connector:
JU1, 2, 3	28-84458M01	male, 2-contact
JU4 thru 12	28-84729L02	male, 3-contact
JU13, 14, 15	28-84528K07	male 22-contact
JU16, 17	28-84729L02	male, 3-contact
JU18	28-84458M01	male, 2-contact
JUVB*	28-84458M01	male, 2-contact
		transistor: (see note)
Q1	48-869649	PNP; type M9649
Q2 thru 5	48-869648	NPN; type M9648
Q6, 7	48-869594	NPN; type M9594
		resistor, fixed: ±5%; 1/4 W: unless otherwise stated
R1 thru 8	6-11009A73	10k
R9	6-11009A49	1k
R10 thru 17	6-11009A09	22
R18	6-11009A49	1k
R19 thru 26	6-11009A09	22
R27	6-11009A73	10k
R28, 29	6-11009A41	470
R30 thru 35	6-11009A49	1k
R36 thru 39	6-11009A73	10k
R40	6-11009A61	3.3k
R41	6-11009A73	10k
R42	6-11009A73	10k
R43, 44	6-11009A61	3.3k
R45	6-11009A73	10k
R46	6-11009A09	22
R47 thru 50	6-11009A49	1k
R51	6-11009A09	22
R52, 53	6-11009A27	120
R54	6-11009A09	22
R55, 56	6-11009A49	1k
R57	6-11009A73	10k
R58	6-11009A09	22
R59, 60	6-11009A73	10k
R61 thru 76	6-11009A09	22
R77	6-11009A73	10k
R78, 79	6-11009A53	1.5k
R80	6-11009A73	10k
R81, 82, 83	6-11009A65	4.7k
R84 thru 107	6-11009A73	10k
R108	6-11009A49	1k
R109	6-11009A73	109k
R110	6-11009A42	510
R111	6-11009A01	10
R112	6-11009D06	220k
R113	6-11009A31	180
R114	6-11009A49	1k
R115	6-11009A29	150
R116	6-11009A49	1k
R117	6-11009A97	100k
R118	6-84640C25	2.1k ±0.5%
R119	6-11009A53	1.5k
R120	6-11009A01	10
R121	6-11009A49	1k
R122	6-11009A58	2.4k
R123	6 84640C25	2.1k ±0 5%
R124	6-84640C21	750 ±0.5%
R125	6-11009A49	1k
R126	6-82672B78	215 ±10%; 1/2 W
R127	6-84640C25	2.1k ±0.5%
R128	6-11009A49	1k
R129	6-11009A73	10k
R131	6-11009A53	1 5k
R132	6-11009A49	1k
R133	6-11009A87	39k
R134, 135	6-11009A49	1k
R136, 137	6-11009A57	2 2k
R138	6-11009A49	1k
R139	6-11009B22	1 meg
R140	6-11009A85	33k
R141, 142, 143	6-11009A73	10k
R144	6-11009A65	4 7k
R145	6-11009A97	100k
R146	6-11009A89	47k
R147, 148	6-11009A09	22
R149 thru 156	6-11009A42	510
R157	6-11009A73	10k
R158, 159	6-11009A42	510
R160	6-11009A73	10k
		thermistor:
RT1, 2	6-84259H01	2.030 ohms @25°C
		switch:
S1	40-84324C17	pushbutton; 2-pole; P-P
S2, 3, 4	40-84324C19	pushbutton; 2-pole, M
S5	40-84324C17	pushbutton, 2-pole, P-P
S6	40-82062L03	switch lock· spst
		integrated circuit: (see note)
U1, 2, 3	51-83627M51	transceiver octal bus inverter
U4 thru 8	51-83627M52	64k × 1 RAM (TRN9725A only)
U9, 10, 11	51-83627M03	octal transparent latch
U12	51-82609M30	dual, 4-bit binary counter
U13	51-84561L52	presentable decode-counter
U14	51-82609M07	oscillator 2 to 20 MHz
U15	51-84371K77	quad bus three-state
U16	51 82609M55	octal buffers with 3-state output
U17 thru 20	51-83627M52	64k × 1 RAM (TRN9725A only)
U21	51-83625M25	8-bit microprocessor
U22, 23	51-82609M57	8-but selector/multiplexer
U24	51-84561L06	quadruple 2-input NOR gate
U25	51-82609M30	dual 4-bit binary counter
U26, 27	51-84561L49	synchronous binary 4-bit counter
U28	51-84371K08	hex buffer driver
U29	51-84371K77	quad bus three-state
U31	51-82609M64	9-bit odd/even parity gen/checker
U32, 33	51-82609M57	8-bus transceiver/3-state output
U34, 35	51-82609M56	octal buffers 3-state output
U36		NOT USED
U37, 38	51-84561L41	3-to-8 line decoder/demultiplexer
U39, 40, 41	51-84371K80	quad receiver DTL line
U42, 43, 44	51-84371K85	ACIA
U45	51-84561L32	PIA
U49	51-83625M70	2k × 8 RAM (TRN9725A & TRN9815A only)
U50 51	51-84371K81	line driver
U52	51-83629M39	comparator
U53	51-84561L04	quad 2-input NAND gate
U54	51-82609M38	hex bus receiver
U55	51-84561L06	quadruple 2-input NOR gate
U56	51-82609M55	octal buffers with 3-state output
U61	51-84561L46	quad 2-in buffer o/c output
U62	51-84561L04	quad 2-input NAND gate
U63	51-84561L34	dual D flip-flop
U64	51-84561L41	3-to-8 line decoder/demultiplexer
U65	51-84561L38	triple 3-inut NOR gate
U66	51-84561L06	quadruple 2-input NOR gate
U67	51-82609M55	octal buffer 3-state output
U68	51-84561L03	hex inverter
U69, 70, 71	51-84561L49	synchronous binary 4-bit counter
U72	51-84561L34	dual D flip-flop
U73	51-83627M49	quad exclusive OR gate
U74	51-84561L03	hex inverter
U75, 76, 77	51-84561L04	quad 2-input NAND gate
U78, 79	51-84561L06	quadruple 2-input NOR gate
U80	51-84371K44	monostable multivibrator
U81	51 84561L52	presettable decade counter
U82	51-82609M37	generator bit-rate
		voltage, regulator: (see note)
VR1	48-83461E17	Zener type; 2.5 V
		crystal: (see note)
Y1	48-84224K06	18 432000 kHz
	mechanical parts	
	3-134184	SCREW, lock: 4-40 × 5/16"; 3 used
	4-129021	LOCKWASHER; 3/4" internal
	9-84181L01	CONNECTOR, 2-contact jumper; 18 used
	9-84728L01	SOCKET, connector
	14-84891E02	INSULATOR, standoff switch; 10 used
	22-84986F01	PIN
	38-84683F01	PUSHBUTTON; 5 used
	41-84891F01	SPRING
	42-84837F01	CLIP
	55-82239K01	LATCH
	61-84989F01	WINDOW, ID
	64-84680F06	PANEL, front
	9-82417L01	CONNECTOR
	9-06320B20	SOCKET, 20-contact; 2 used
	9-82808R10	SOCKET, 28-contact; 8 used

TRN9306B Receiver Site Control Programmable Logic PL-9991-A

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		integrated circuit: (see note)
U30	51-84061P09	Programmed PAL

TRN5726B Central Site Controller Pal 1 PL-9992-A

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		integrated circuit: (see note)
U30	51-84061P08	programmed PAL

TRN9309A TSC Software PL-9993-A

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		integrated circuit: (see note)
U57	51-90008L18	2k × 8 bit EPROM programmed

TRN5727A TSC 6809 Pal 2 PL-9994-A

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		integrated circuit: (see note)
U36	51-84061P02	programmed PAL

TRN9995A Static RAM PL-11116-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
	non-referenced item	
	5184064F64	32k × 8 150nS static RAM (see note)

TRN9996A Dynamic RAM PL-11117-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		integrated circuit: (see note)
U4 thru 8	5184064F71	CMOS dynamic RAM
U17 thru 20	5184064F71	CMOS dynamic RAM

TVN6046A *SMARTNET II* CSC Software PL-11118-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		integrated circuit: (see note)
U46	5190043C76	programmed IC
U47	5190043C75	programmed IC
U57	5190043C80	programmed IC
U58	5190043C79	programmed IC
U59	5190043C78	programmed IC
U60	5190043C77	programmed IC

TVN6047A *SMARTNET II* CSC Code Plug PL-11119-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		integrated circuit: (see note)
U48	5190043C83	programmed IC

TVN6049A *SMARTNET II* TSC Software PL-11121-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		integrated circuit: (see note)
U57	5190043C91	programmed IC

TVN6050A *SMARTNET II* RSC Software PL-11122-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		integrated circuit: (see note)
U57	5190043C88	programmed IC

TVN6051A *SMARTNET II* TCI Software PL-11126-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		integrated circuit: (see note)
U57	5190043C89	programmed IC

TRN9687A *SMARTNET* CSC Software 1 PL-9996-A

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		integrated circuit: (see note)
U48	51-90008H58	8k × 8 bit EPROM programmed
U47	51-90008H59	8k × 8 bit EPROM
U46	51-90008H60	8k × 8 bit EPROM
U60	51-90008H61	8k × 8 bit EPROM
U59	51-90008H62	8k × 8 bit EPROM
U58	51-90008H63	8k × 8 bit EPROM
U57	51-90008H64	8k × 8 bit EPROM

TRN9806A CSC Software 1 PL-9997-A

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		integrated circuit: (see note)
U48	51-90008L08	8k × 8 bit EPROM
U47	51-90008L09	8k × 8 bit EPROM
U46	51-90008L10	8k × 8 bit EPROM
U60	51-90008L11	8k × 8 bit EPROM
U59	51-90008L12	8k × 8 bit EPROM
U58	51-90008L13	8k × 8 bit EPROM
U57	51-90008L14	8k × 8 bit EPROM

TRN9679A Pal CSC09 PL-9998-A

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		integrated circuit: (see note)
U36	51-84061P07	programmed PAL

TRN9308A Software RSC PL-9999-A

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		integrated circuit: (see note)
U57	51-90008L17	8k × 8 EPROM programmed

TRN9307A RSC PAL 2 PL-10000-A

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		integrated circuit: (see note)
U36	51-84061P06	programmed PAL

TRN9889A *SMARTNET* CSC Software 2 PL-10817-B

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		integrated circuit: (see note)
U47	51-90043C69	32k × 8 bit EPROM
U46	51-90043C70	32k × 8 bit EPROM
U60	51-90043C71	32k × 8 bit EPROM
U59	51-90043C72	32k × 8 bit EPROM
U58	51-90043C73	32k × 8 bit EPROM
U57	51-90043C74	32k × 8 bit EPROM

TRN9888A PAL, 6-Page, CSC09 PL-10818-A

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		integrated circuit: (see note)
U36	51-84061P11	programmed PAL
U49	51-84944N51	8k × 8 RAM
	mechanical part	
	54-82614P01	LABEL, copyright

TRN9891A Code Plug PL-10819-A

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		integrated circuit: (see note)
U48	51-90008H81	8k × 8 bit EPROM programmed

TRN9905A Privacy Plus CSC Software Type II PL-10886-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		integrated circuit, programmed: (see note)
U46	5190043C52	32k x 8 bit EPROM
U47	5190043C51	32k x 8 bit EPROM
U57	5190043C56	32k x 8 bit EPROM
U58	5190043C55	32k x 8 bit EPROM
U59	5190043C54	32k x 8 bit EPROM
U60	5190043C53	32k x 8 bit EPROM

TRN9907A Privacy Plus TSC Software Type II PL-10887-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		integrated circuit: (see note)
U57	5190008L07	8k x 8 EPROM programmed

TRN9968A Site Controller Board PL-11063-A

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		battery:
BT1, 2	6084542P01	cadmium nickel; 2.4 V
		capacitor, fixed; uF ±5%: unless otherwise stated
C1	2384669A19	100 -10 + 150%, 20 V
C2	2384669A25	15 -10 + 150%; 25 V
C3	0811044A28	0.15, 50/63 V
C4 5	2384669A25	15 -10 + 150%, 25 V
C6	0811044A28	0 15, 50/63 V
C7	2182213E17	470 pF ±10%; 100 V
C8	0884637L23	0.1; 100 V
C9	2182187B16	.003 ±10%, 100 V
C10 thru 15	2184426B33	330 pF; 500 V
C16	2384669A25	15 -10 + 150%, 25 V
C17	0882317B01	0.1 ±10%; 100 V
C18	2182213E10	240 pF, 100 V
C19	2384669A25	15 -10 + 150%; 25 V
C20 thru 28	0811044A30	0.33, 50/63 V
C29 thru 36	0811044A28	0.15, 50/63 V
C37	2182187B11	.0015 ±10%, 100 V
C38 thru 98	0811044A28	0 15, 50/63 V
C99	2111022G44	39 pF, 50 V
C100	2111022G41	30pF, 50 V
C101 thru 107	0811044A28	0.15, 50/63 V
		diode: (see note)
CR1, 2	4882525G23	silicon
CR3	4883654H01	silicon
CR4	4882466H13	silicon
CR7	4884616A01	hot carrier
CR8	4882466H13	silicon
CR9, 10	4883654H01	silicon
		light emitting diode: (see note)
DS1	4888245C22	green
DS2	4888245C24	red
DS3	4888245C23	yellow
DS4	4888245C24	red
DS5	4888245C23	yellow
		connector:
JU1 thru 3	2884458M01	male: 2-contact
JU4 thru 12	2810773A17	male 3-contact
JU13 thru 15	2810773A09	male 22-contact
JU16, 17	2810773A17	male 3-contact
JU18	2884458M01	male: 2-contact
JU19, 20	2810773A17	male 3-contact
JU21, 22	2884458M01	male: 2-contact
		transistor: (see note)
Q1	4800869649	PNP type M9649
Q2 thru 5	4800869648	NPN type M9648
Q6, 7	4800869594	NPN type M9594
Q8	4800869795	PNP type M9795
Q9	4800869571	PNP type M9571
		resistor, fixed: ±5%; 1/4 W: unless otherwise stated
R1 thru 8	0611009A73	10k
R9	0611009A49	1000
R10 thru 17	0611009A09	22
R18	0611009A49	1000
R19 thru 26	0611009A09	22
R27	0611009A73	10k
R28	1883452F33	var 20k ±10% 1/2 W
R29	0611009A84	30k
R30 thru 35	0611009A49	1000
R36 thru 39	0611009A73	10k
R40	0611009A61	3300
R41	0611009A73	10k
R42	0611009A09	22
R43,44	0611009A61	3300
R45	0611009A73	10k
R46	0611009A09	22
R47 thru 50	0611009A49	1000
R51	0611009A09	22
R52, 53	0611009A27	120
R54	0611009A09	22
R55, 56	0611009A49	1000
R57	0611009A73	10k
R58	0611009A09	22
R59, 60	0611009A73	10k
R61 thru 76	0611009A09	22
R77	0611009A73	10k
R78, 79	0611009A53	1500
R80	0611009A49	1000
R81 thru 83	0611009A65	4700
R84 thru 107	0611009A73	10k
R108	0611009A49	1000
R109	0611009A73	10k
R110	0611009A42	510
R111	0611009A01	10
R112	0611009B06	220k
R113	0611009A31	180
R114	0611009A49	1000
R115	0611009A29	150
R116	0611009A49	1000
R117	0611009A97	100k
R118	0684640C25	2100 ±0 5%
R119	0611009A53	1500
R120	0611009A01	10
R121	0611009A49	1000
R122	0611009A58	2400
R123	0684640C25	2100 ±0 5%
R124	0684640C21	750 ±0 5%
R125	0611009A49	1000
R126	0682672B78	215 ±1% 1/2 W
R127	0684640C25	2100 ±0 5%
R128	0611009A49	1000
R129	0611009A73	10k
R131	0611009A53	1500
R132	0611009A49	1000
R133	0611009A87	39k
R134, 135	0611009A49	1000
R136 137	0611009A57	2200
R138	0611009A49	1000
R139	0611009B22	1 meg
R140	0611009A85	33k
R141 thru 143	0611009A73	10k
R144	0611009A65	4700
R145	0611009A97	100k
R146	0611009A89	47k
R147, 148	0611009A09	22
R149 thru 156	0611009A42	510
R157	0611009A73	10k
R158, 159	0611009A42	510
R160 161	0611009A73	10k
R162	0611009A22	[illegible]
R163	0611009A31	180
R164	0611009A39	390
R165	0611009A61	3300
R166 thru 169	0611009A39	390
R170	0611009A09	22
R171	0611009A73	10k
R172	0611009A61	3300
R173	0611009A27	120
R174	0611009A29	150
R175	0611009A61	3300
R176	0611009A73	10k
R177	0611009A49	1000
		thermistor:
RT1 2	0684259H01	2 030 ohms @ 25° C
		switch
S1	4084324C17	pushbutton 2-pole, P-P
S2 thru 4	4084324C19	pushbutton 2-pole M
S5	4084324C17	pushbutton 2-pole, P-P
S6	4082062L04	switch, lock spst
		integrated circuit: (see note)
U1 thru 3	5184810F34	transceiver octal bus inverter
U9 10	5182802R22	latch
U11	5182802R07	9-bit transparent latch
U12	5184118K63	dual 4-bit binary counter
U13	5184118K47	presettable decade counter
U14	4883673R01	15 84 MHz oscillator
U15	5184320A87	quad bus 3-state driver/receiver
U16	5182369T05	octal buffer line driver
U21	5184437N39	8-bit microprocessor
U22, 23	5182369T07	bus transceiver
U24	5182369T02	quad 2-input NOR gate
U25	5184118K63	dual 4-bit binary counter
U26, 27	5184118K44	synchronous binary 4-bit counter
U28	5184084D64	hex buffer driver
U29	5184320A87	quad bus 3-state driver/receiver
U31	5182369T08	9-bit odd/even parity generator/checker
U32 33	5182369T07	bus transceiver
U34, 35	5182369T06	octal buffer line driver
U37 38	5182369T04	1-of-8 decoder/demultiplexer
U39 thru 41	5184320A90	quad receiver DTL line
U42 thru 44	5184437N36	1 5 MHz ACIA
U45	5184437N40	PIA
U50, 51	5184320A91	TTL/DTL-to-MOS line driver
U52	5184621K74	comparator
U53	5184118K06	quad 2-input NAND gate
U54	5182807K22	hex bus receiver
U55	5182369T02	quad 2-input NOR gate
U56	5182369T05	octal buffer line driver
U61	5184118K41	quad 2-input positive NOR buffer
U62	5184118K06	quad 2-input NAND gate
U63	5184118K01	dual D edge trigger flip-flop
U64	5182369T04	1-of-8 decoder/demultiplexer
U65	5184118K18	triple 3-input NOR gate
U66	5184118K01	dual D edge trigger flip-flop
U67	5182369T05	octal buffer line driver
U68	5182369T03	hex inverter
U69 thru 71	5184118K44	synchronous binary 4-bit counter
U72	5184118K01	dual D edge trigger flip-flop
U73	5184118K21	quad exclusive OR gate
U74	5184118K05	hex inverter
U75	5182369T01	quad 2-input NAND gate
U76	5184118K06	quad 2-input NAND gate
U77	5182369T01	quad 2-input NAND gate
U78	5182369T02	quad 2-input NOR gate
U79	5184118K13	quad 2-input NOR gate
U80	5184084D27	dual monostable multivibrator
U81	5184118K47	presettable decade counter
U82	5182807K14	bit-rate generator
U83	5184118K56	octal D flip-flop w/3-state output
		voltage regulator: (see note)
VR1	4883461E17	Zener 2.5 V
		crystal
Y1	4883853F02	1.843 MHz
	non-referenced items	
	0300134184	SCREW, lock 4-40 × 5/16; 3 used
	0400129021	LOCKWASHER 3/4 internal
	0982808R05	SOCKET, 18-contact for U4-U8, U17-U20
	0982808R06	SOCKET, 20-contact· for U30, U36
	0982808R10	SOCKET, 28-contact for U46-U49, U57-U60
	0984181L01	CONNECTOR, 2-contact jumper; 21 used
	0984728L01	SOCKET, connector 2-contact
	1484583B02	INSULATOR for Y1
	1484891E02	INSULATOR, standoff switch, 10 used
	3884683F01	PUSHBUTTON, 5 used
	4184891F01	SPRING
	4284837F01	CLIP
	5483865R01	LABEL, bar code
	5582239K01	LATCH
	6184989F01	WINDOW, ID
	6484680F15	PANEL, front

TRN7046A *SMARTNET II* TCI/DCB PAL PL-11130-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		integrated circuit: (see note)
U57	5190043C87	programmed IC

TVN6052A *SMARTNET II* DCB Software PL-11127-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		integrated circuit: (see note)
U57	5190043C90	programmed IC

TVN6053A *SMARTNET II* ReSC Software PL-11128-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		integrated circuit: (see note)
U57	5190043C87	programmed IC

note: For optimum performance, diodes, transistors, and integrated circuits must be ordered by Motorola part numbers

TRN7047A *SMARTNET II* CSC PAL PL-11387-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
U57	5184061P14	programmed PAL

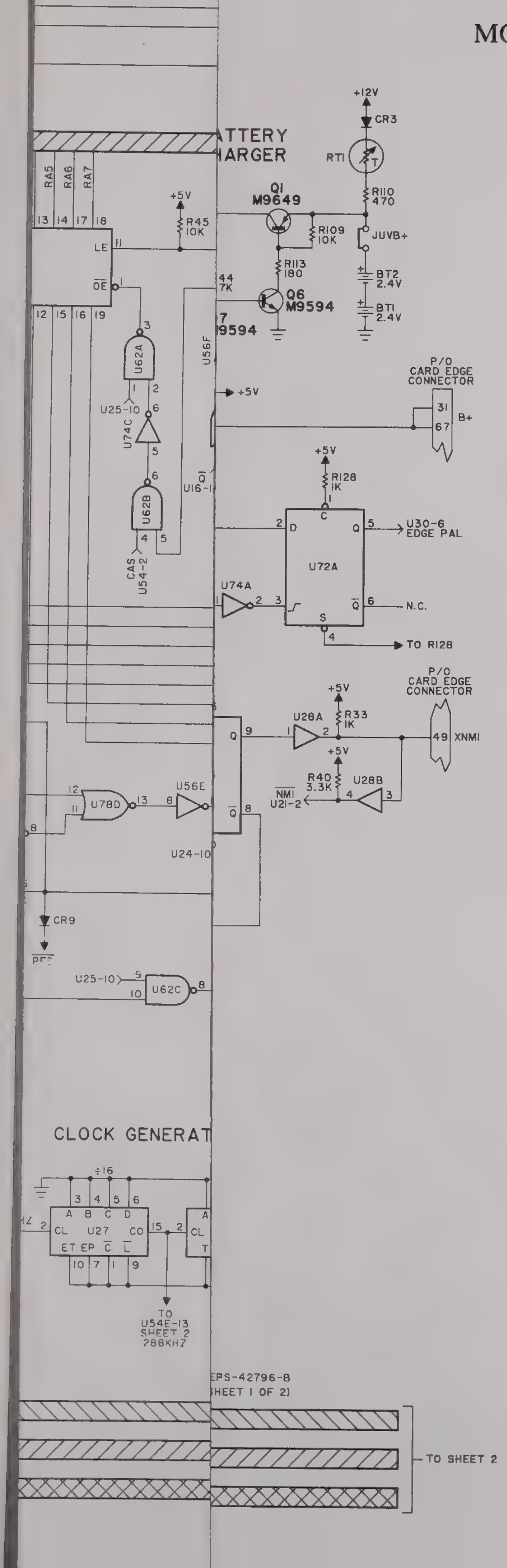
TRN7048A RSC/RESC Type II PAL PL 11388-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
U57	5184061P13	programmed PAL

TRN7049A 6 Page PAL CSC PL-11389-O

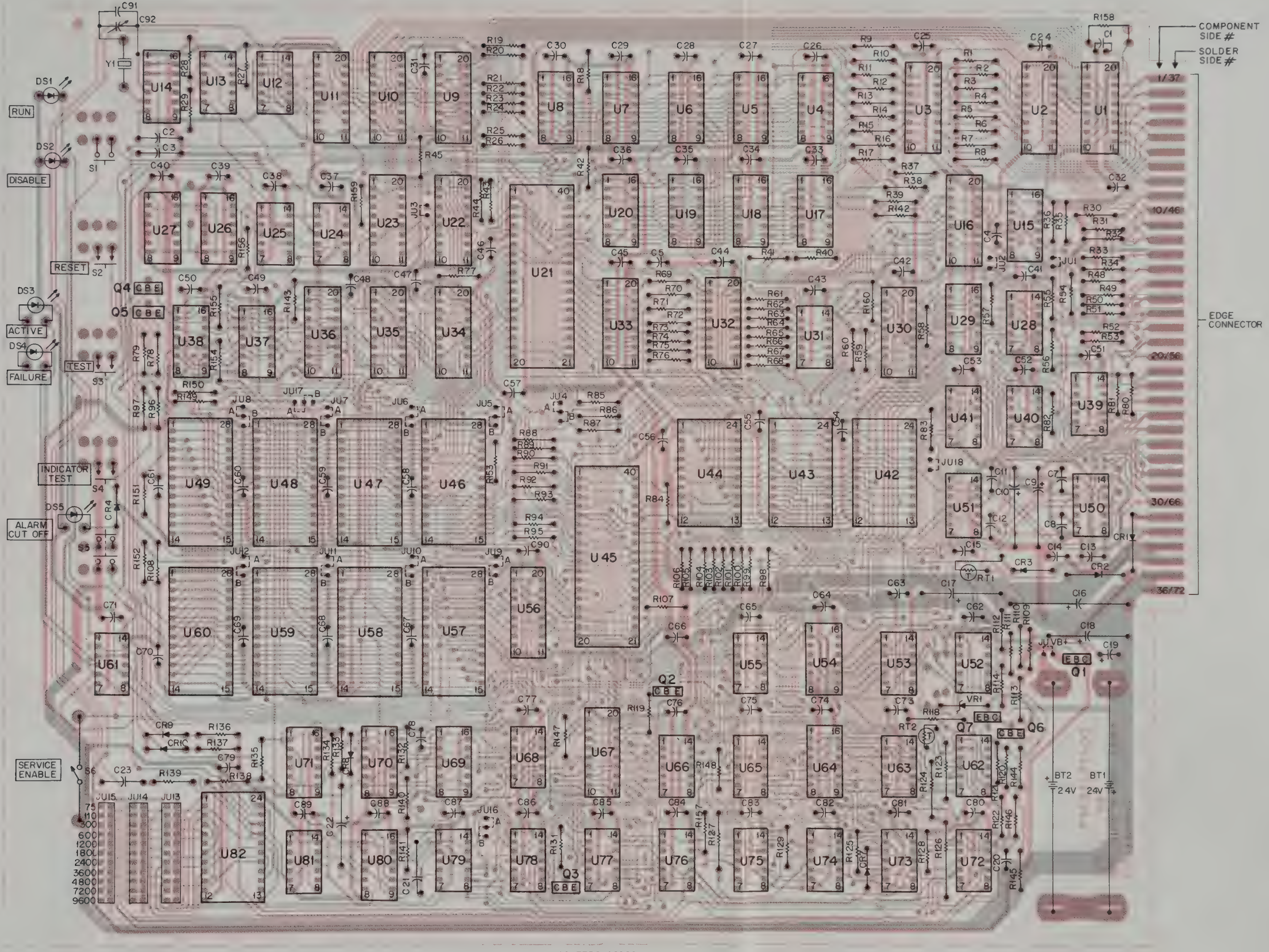
REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
U57	5184061P11	programmed PAL

EARLIER VERSION
SITE CONTROLLER BOARD
MODELS TLN2997A, 99A, 3000A, 01A, 11A, 12A
SCHEMATIC DIAGRAM


TTERY
IARGER
RA5
RA6
RA7
LE
OE
+5V
R45
10K
Q1
M9649
R109
10K
R113
180
Q6
M9594
+12V
CR3
RT1
R110
470
JUVB+
BT2
2.4V
BT1
2.4V
U62A
U25-10
U74C
U62B
CAS
U54-2
U56F
U16-1
+5V
P/O
CARD EDGE
CONNECTOR
31
67
B+
+5V
R128
1K
U72A
D
C
Q
S
U30-6
EDGE PAL
N.C.
TO R128
U74A
P/O
CARD EDGE
CONNECTOR
+5V
U28A
R33
1K
49
XNMI
+5V
R40
3.3K
U28B
NMI
U21-2
U78D
U56E
U24-10
CR9
PFE
U25-10
U62C
CLOCK GENERAT
÷16
A B C D
CL U27 CO
ET EP C L
TO
U54E-13
SHEET 2
288KHZ
EPS-42796-B
SHEET 1 OF 2)
TO SHEET 2

EARLIER VERSION SITE CONTROLLER BOARD

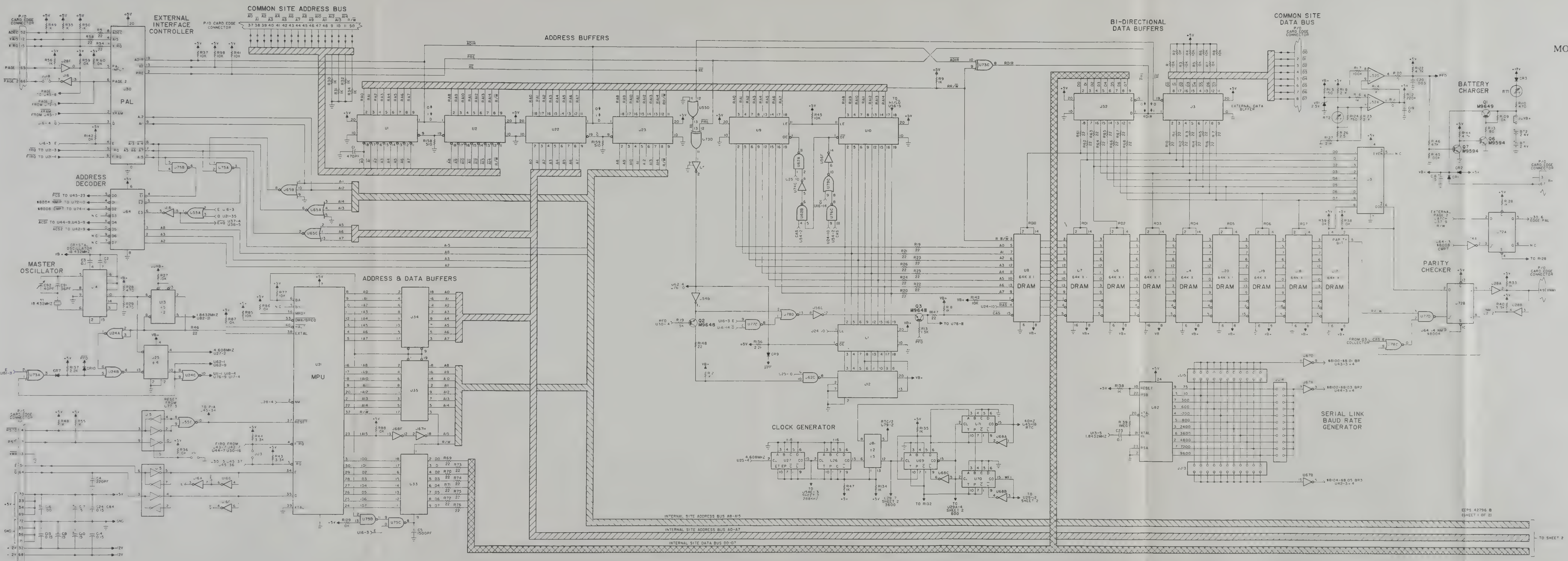
MODELS TLN2997A, 99A, 3000A, 01A, 11A, 12A
CIRCUIT BOARD DETAIL



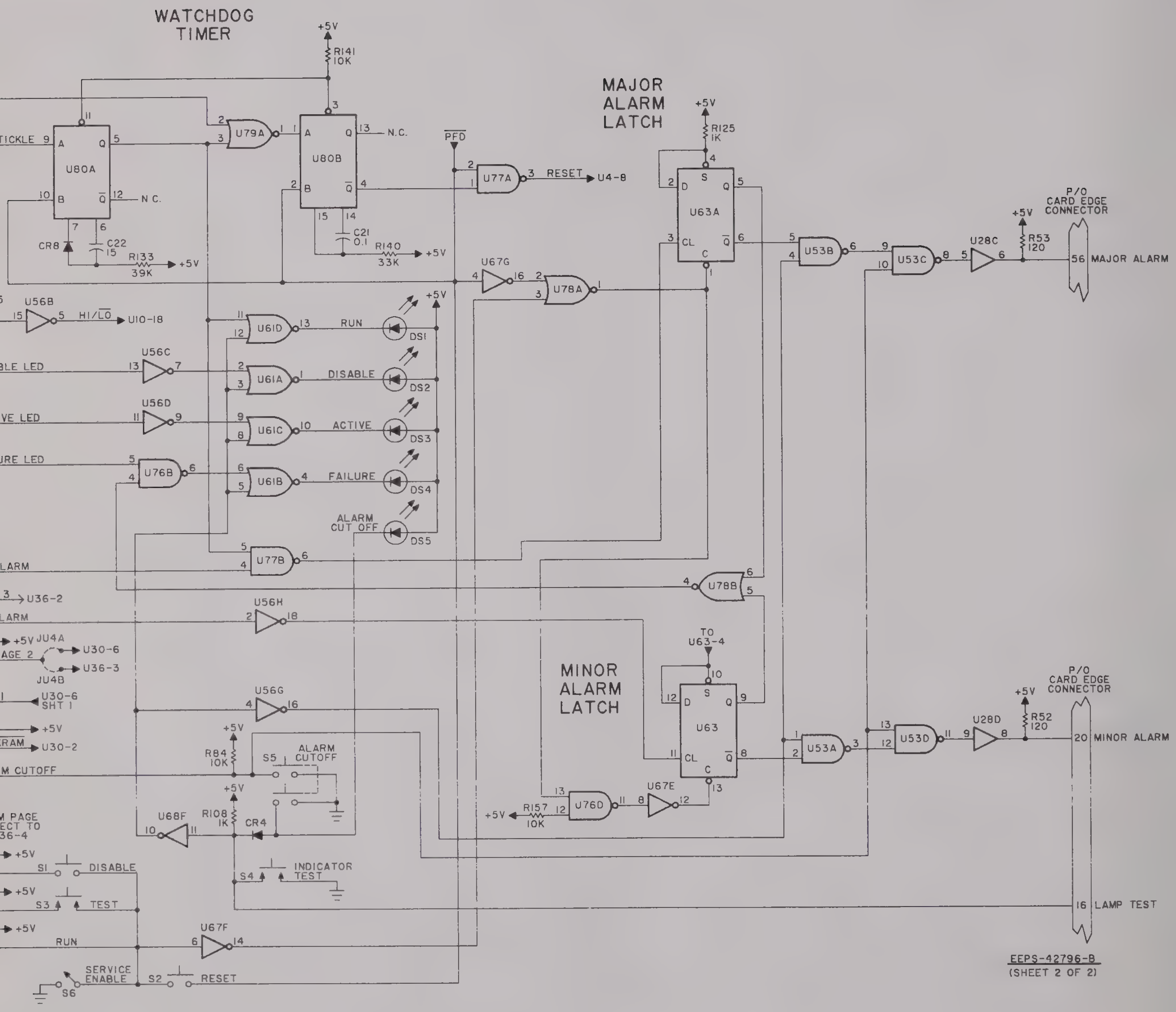
RUN
DISABLE
RESET
ACTIVE
FAILURE
TEST
INDICATOR TEST
ALARM CUT OFF
SERVICE ENABLE
DS1
DS2
DS3
DS4
DS5
S1
S2
S3
S4
S5
S6
COMPONENT SIDE #
SOLDER SIDE #
EDGE CONNECTOR
1/37
10/46
20/56
30/66
36/72
75
110
300
600
1200
1800
2400
3600
4800
7200
9600
JU15
JU14
JU13
BT2 24V
BT1 24V

COMPONENT SIDE BD-EEPS-42226-A
SOLDER SIDE BD-EEPS-42227-B
OL-EEPS-42228-B

SHOWN FROM COMPONENT SIDE


EXTERNAL INTERFACE CONTROLLER
COMMON SITE ADDRESS BUS
ADDRESS BUFFERS
BI-DIRECTIONAL DATA BUFFERS
COMMON SITE DATA BUS
BATTERY CHARGER
PAL
ADDRESS DECODER
MASTER OSCILLATOR
ADDRESS & DATA BUFFERS
MPU
DRAM
PARITY CHECKER
CLOCK GENERATOR
SERIAL LINK BAUD RATE GENERATOR
INTERNAL SITE ADDRESS BUS A8-A15
INTERNAL SITE ADDRESS BUS A0-A7
INTERNAL SITE DATA BUS D0-D7
TO SHEET 2

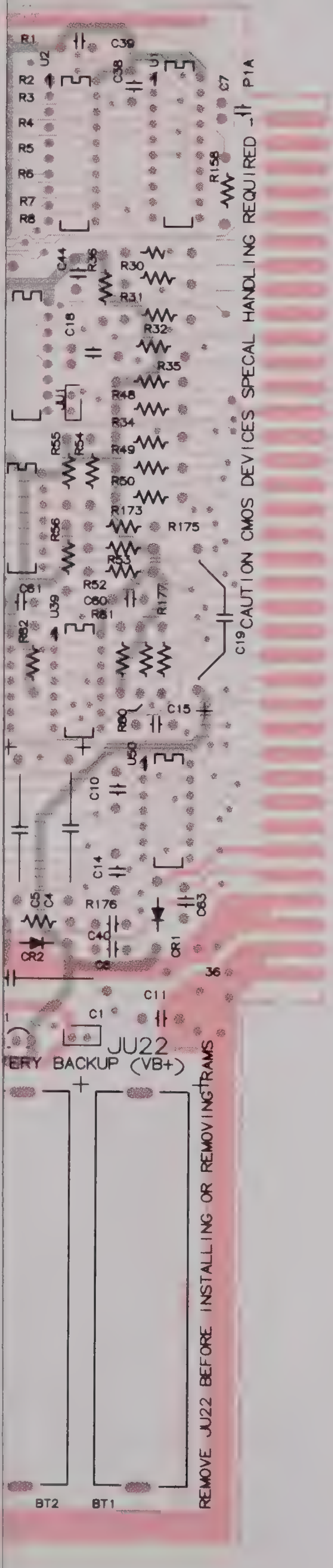
EARLIER VERSION
SITE CONTROLLER BOARD
MODELS TLN2997A, 99A, 3000A, 01A, 11A, 12A
SCHEMATIC DIAGRAM


WATCHDOG TIMER
MAJOR ALARM LATCH
MINOR ALARM LATCH
+5V
R141 10K
TICKLE
U80A
N.C.
CR8
C22 15
R133 39K
U79A
U80B
C21 0.1
R140 33K
PFD
U77A
RESET
U4-8
R125 1K
U63A
S
D
Q
CL
C
U53B
U53C
U28C
R53 120
P/O CARD EDGE CONNECTOR
56 MAJOR ALARM
U67G
U78A
U56B
HI/LO
U10-18
U61D
RUN
DS1
U56C
BLE LED
U61A
DISABLE
DS2
U56D
VE LED
U61C
ACTIVE
DS3
URE LED
U76B
U61B
FAILURE
DS4
ALARM CUT OFF
DS5
U77B
LARM
U36-2
U78B
U56H
JU4A
AGE 2
U30-6
U36-3
JU4B
U30-6 SHT 1
TO U63-4
U63
U56G
U53A
U53D
U28D
R52 120
20 MINOR ALARM
RAM
U30-2
R84 10K
S5
ALARM CUTOFF
M CUTOFF
M PAGE
ECT TO
36-4
U68F
R108 1K
CR4
U76D
U67E
R157 10K
S1
S3
TEST
S4
INDICATOR TEST
16 LAMP TEST
U67F
SERVICE ENABLE
S6
S2

EEPS-42796-B
(SHEET 2 OF 2)

CURRENT VERSION
SITE CONTROLLER BOARD

MODEL TRN9968A
CIRCUIT BOARD DETAIL


R1
U2
C39
C38
U1
C7
P1A
R2
R3
R4
R5
R6
R7
R8
R158
CAUTION CMOS DEVICES SPECAL HANDLING REQUIRED
C44
R36
R30
R31
C18
R32
R35
JU1
R48
R34
R55
R54
R49
R50
R173
R56
R175
R53
C61
R52
C60
R81
R177
U39
R82
C19
C15
R80
U50
C10
C14
C5
C4
R176
C40
CR1
C63
CR2
C8
36
C11
C1
JU22
ERY BACKUP (VB+)
REMOVE JU22 BEFORE INSTALLING OR REMOVING RAMS
BT2
BT1

EARLIER VERSION
SITE CONTROLLER BOARD

MODELS TLN2997A, 99A, 3000A, 01A, 11A, 12A
SCHEMATIC DIAGRAM

Table 2. Jumper Usage

Jumper Ref	Application vs. Position				
	TLN2997A CSC	TLN3010A MCB TLN3011A CSC TLN3006A CSC	TLN3001A RSC	TLN3000A TLN3012A TSC	TLN2999A MCB
JU1	Out	Out	Out	Out	Out
JU2	In	In	In	Out	Out
JU3	Out	Out	In	In	Out
JU4	A	A	A	A	A
JU5	B	A	B	B	B
JU6	B	A	B	B	B
JU7	B	B	B	B	B
JU8	B	B	B	B	B
JU9	B	A	B	B	B
JU10	B	A	B	B	B
JU11	B	A	B	B	B
JU12	B	A	B	B	B
JU13	4800 baud	4800 baud	4800 baud	4800 baud	300 baud
JU14	4800 baud	4800 baud	4800 baud	4800 baud	4800 baud
JU15	4800 baud	4800 baud	4800 baud	4800 baud	4800 baud
JU16	Lower	Lower	Lower	Lower	Lower
JU17	B	B	A	A	A
JU18	Out	Out	Out	Out	Out
JUVB+	See Note 3				

NOTES:

1. Pin #'s on inside row denote 24-pin socket, pin #'s on outside row denote 28-pin socket
2. Unless otherwise specified, all resistor values are in ohms, all capacitor values are in microfarads.
3. Remove jumper JUVB+ when inserting or removing static or dynamic RAMS from circuit.
4. *Indicates open collector output.
5. Table 1 shows IC types and power pin connections.
6. Table 2 shows jumper usage for this board.

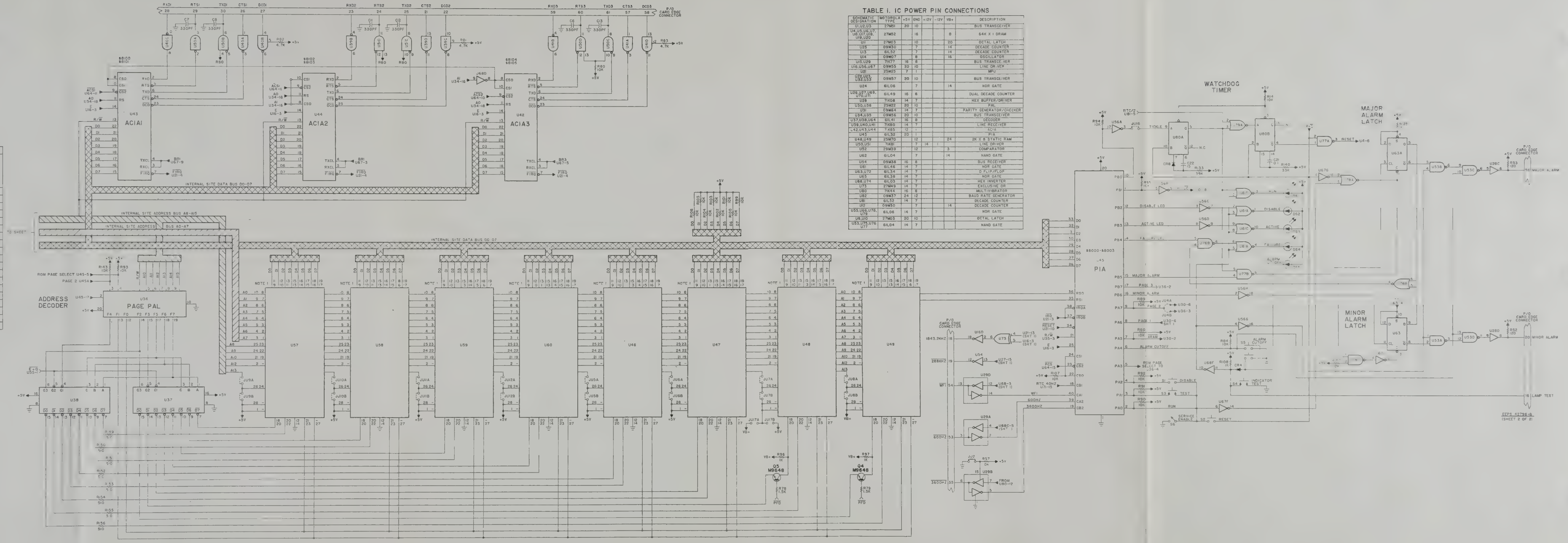
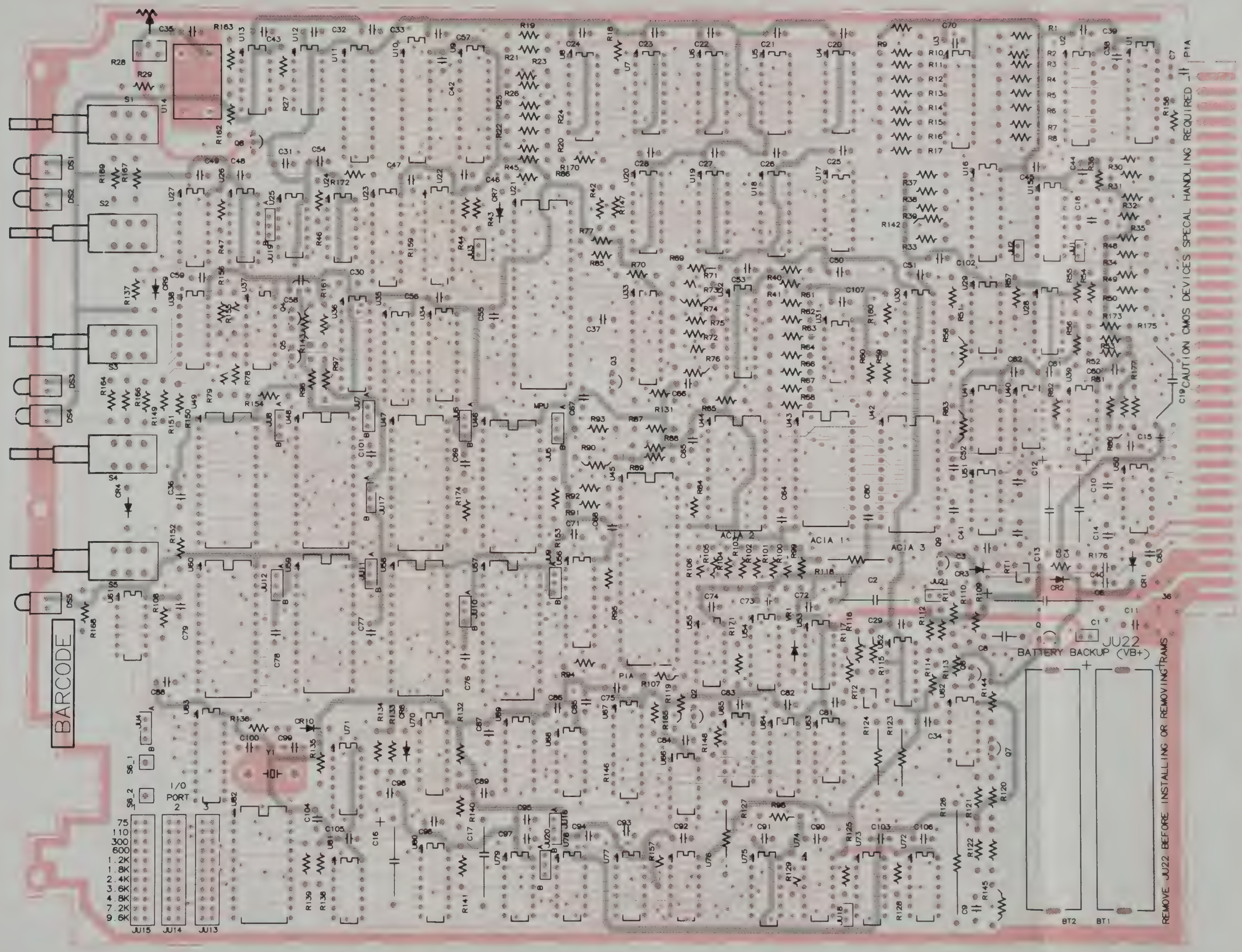

ACIA1
ACIA2
ACIA3
U43
U44
U42
INTERNAL SITE DATA BUS D0-D7
INTERNAL SITE ADDRESS BUS A8-A15
INTERNAL SITE ADDRESS BUS A0-A7
TO SHEET
ADDRESS DECODER
PAGE PAL
U36
U38
U37
U57
U58
U59
U60
U46
U47
U48
U49
Q5 M9648
Q4 M9648
P/O CARD EDGE CONNECTOR
PIA
U45
WATCHDOG TIMER
MAJOR ALARM LATCH
MINOR ALARM LATCH
MAJOR ALARM
MINOR ALARM
LAMP TEST
DISABLE
ACTIVE
FAILURE
ALARM CUTOFF
INDICATOR TEST
SERVICE ENABLE
RESET
RUN
TEST

TABLE I. IC POWER PIN CONNECTIONS

SCHEMATIC DESIGNATION	MOTOROLA TYPE	+5V	GND	+12V	-12V	VB+	DESCRIPTION
U1,U2,U3	27M51	20	10				BUS TRANSCEIVER
U4,U5,U6,U7, U8,U17,U18, U19,U20	27M52		16			8	64K X 1 DRAM
U11	27M03		10			20	OCTAL LATCH
U25	09M30		7			14	DECADE COUNTER
U13	61L52		7			14	DECADE COUNTER
U14	09M07		8			16	OSCILLATOR
U15,U29	71K77	16	8				BUS TRANSCEIVER
U16,U56,U67	09M55	20	10				LINE DRIVER
U21	25M25	7	1				MPU
U22,U23, U32,U33	09M57	20	10				BUS TRANSCEIVER
U24	61L06		7			14	NOR GATE
U26,U27,U69, U70,U71	61L49	16	8				DUAL DECADE COUNTER
U28	71K08	14	7				HEX BUFFER/DRIVER
U30,U36	25M22	20	10				PAL
U31	09M64	14	7				PARITY GENERATOR/CHECKER
U34,U35	09M56	20	10				BUS TRANSCEIVER
U37,U38,U64	61L41	16	8				DECODER
U39,U40,U41	71K80	14	7				LINE RECEIVER
U42,U43,U44	71K85	12	1				ACIA
U45	61L32	20	1				PIA
U48,U49	25M70		12			24	2K X 8 STATIC RAM
U50,U51	71K81		7	14	1		LINE DRIVER
U52	29M39		12			3	COMPARATOR
U62	61L04		7			14	NAND GATE
U54	09M38	16	8				BUS RECEIVER
U61	61L46	14	7				NOR GATE
U63,U72	61L34	14	7				D FLIP/FLOP
U65	61L38	14	7				NOR GATE
U68,U74	61L03	14	7				HEX INVERTER
U73	27M49	14	7				EXCLUSIVE OR
U80	71K44	16	8				MULTIVIBRATOR
U82	09M37	24	12				BAUD RATE GENERATOR
U81	61L52	14	7				DECADE COUNTER
U12	09M30		7			14	DECADE COUNTER
U55,U66,U78, U79	61L06	14	7				NOR GATE
U9,U10	27M03	20	10				OCTAL LATCH
U53,U75,U76 U77	61L04	14	7				NAND GATE

EEPS 42796-B (SHEET 2 OF 3)

CURRENT VERSION
SITE CONTROLLER BOARD
MODEL TRN9968A
CIRCUIT BOARD DETAIL


BARCODE
S1
S2
S3
S4
S5
DS1
DS2
DS3
DS4
DS5
MPU
ACIA 1
ACIA 2
ACIA 3
PIA
I/O PORT
1
2
3
75
110
300
600
1.2K
1.8K
2.4K
3.6K
4.8K
7.2K
9.6K
JU15
JU14
JU13
JU22
BATTERY BACKUP (VB+)
BT2
BT1
REMOVE JU22 BEFORE INSTALLING OR REMOVING RAMS
CAUTION CMOS DEVICES SPECIAL HANDLING REQUIRED
P1A
36

SOLDER SIDE BD-CEPS-45813-0
COMPONENT SIDE BD-CEPS-45812-0
OL-CEPS-45814-0

CURRENT VERSION
SITE CONTROLLER BOARD
MODEL TRN9968A
SCHEMATIC DIAGRAM
DATA BUFFERS & DRAM CIRCUITRY

CURRENT VERSION
SITE CONTROLLER BOARD
MODEL TRN9968A
BLOCK DIAGRAM

NOTES:

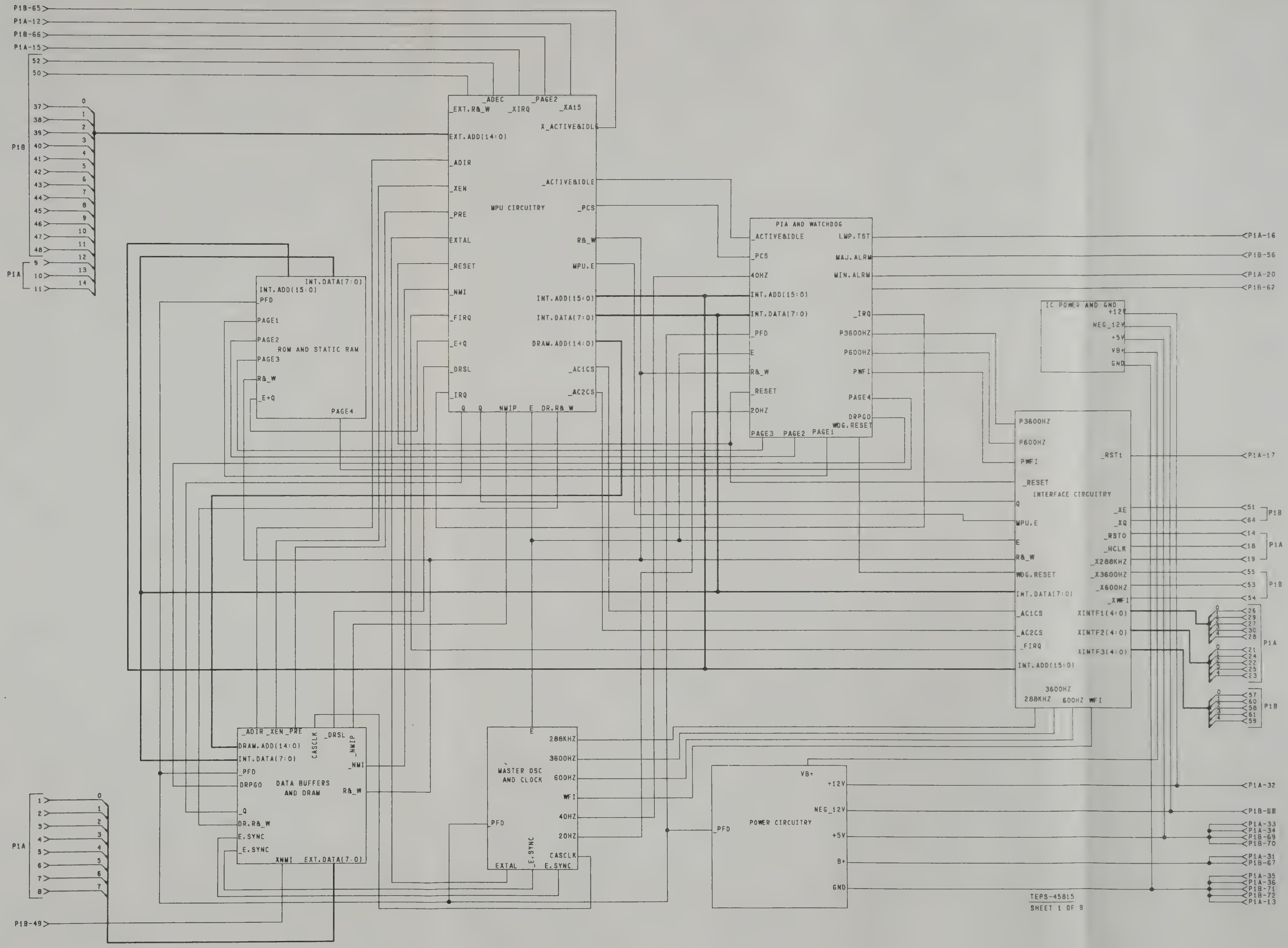
1. Unless otherwise specified, all resistor values are in ohms and all capacitor values are in microfarads.
2. For U46-U49 and U57-U60; the pin #'s of the inside row denote a 24-pin socket, and the pin #'s of the outside row denote a 28-pin socket.

> **IMPORTANT**
> When a single SRAM is used, it MUST be installed as U49. Position U48 is used only when both SRAMs are used.

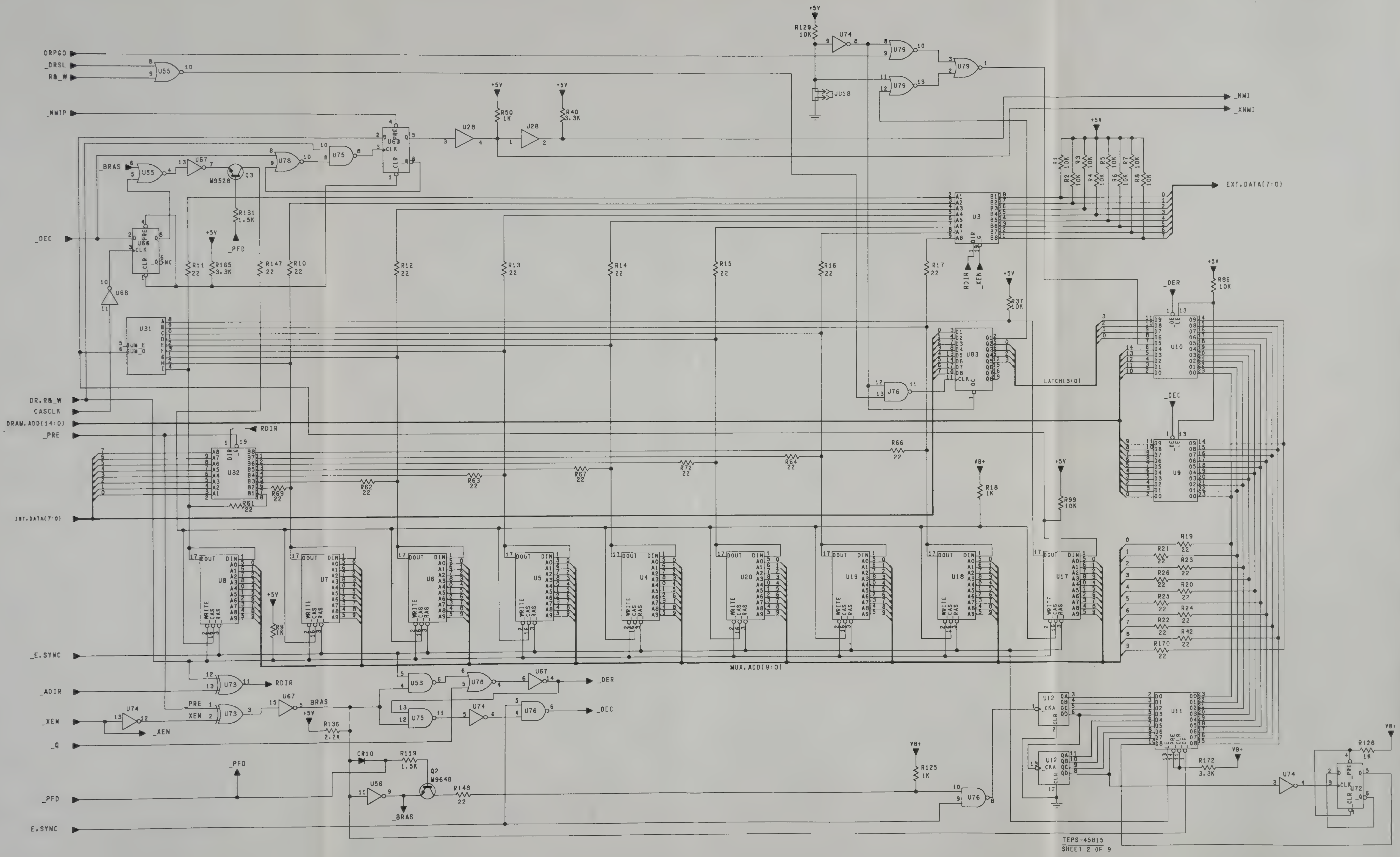
3. In the Power Circuitry of the circuit, remove jumper JU22 when inserting or removing static or dynamic RAMs from their sockets.
4. Table 1 lists the jumper usage for this board.

Table 1. Jumper Usage

Jumper Reference	Application vs. Position						
	TLN2997A CSC	TLN3011A CSC TLN3006A CSC	TLN3033A CSC	TLN3035A TSC TLN3000A TSC	TLN3036A RSC TLN3001A RSC	TLN2999A MCB	TLN3034A MCB TLN3010A MCB
JU1	Out	Out	Out	Out	Out	Out	Out
JU2	In	In	In	Out	In	Out	Out
JU3	Out	Out	Out	In	In	Out	Out
JU4	A	A	A	A	A	A	A
JU5	B	A	A	B	B	B	A
JU6	B	A	A	B	B	B	A
JU7	B	B	A	B	B	B	B
JU8	B	B	B	B	B	B	B
JU9	B	A	A	A	A	B	A
JU10	B	A	A	B	B	B	A
JU11	B	A	A	B	B	B	A
JU12	B	A	A	B	B	B	A
JU13	4800 baud	4800 baud	4800 baud	4800 baud	4800 baud	300 buad	300 baud
JU14	4800 baud	4800 baud	4800 baud	4800 baud	4800 baud	4800 baud	4800 baud
JU15	4800 baud	4800 baud	4800 baud	4800 baud	4800 baud	4800 baud	4800 baud
JU16	Upper	Upper	Upper	Upper	Upper	Upper	Upper
JU17	B	B	B	A	A	A	B
JU18	Out	Out	In	Out	Out	Out	Out
JU19	B	B	B	B	B	B	B
JU20	Upper	Upper	Upper	Upper	Upper	Upper	Upper
JU21	Out	Out	Out	Out	Out	Out	Out
JU22	In	In	In	In	In	In	In
JU23	A	A	A	A	A	A	A

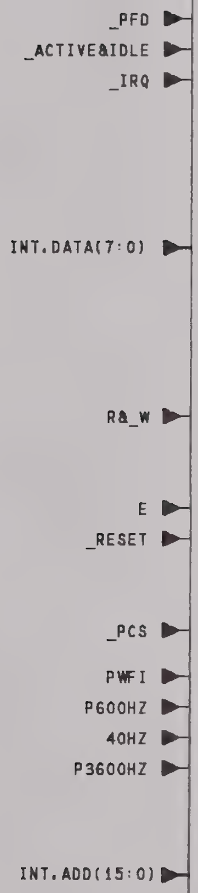

P1B-65
P1A-12
P1B-66
P1A-15
52
50
P1B
P1A
MPU CIRCUITRY
_ADEC
_PAGE2
_EXT.R&_W
_XIRQ
_XA15
X_ACTIVE&IDLE
EXT.ADD(14:0)
_ADIR
_XEN
_PRE
EXTAL
_RESET
_NMI
_FIRQ
_E+Q
_DRSL
_IRQ
_ACTIVE&IDLE
_PCS
R&_W
MPU.E
INT.ADD(15:0)
INT.DATA(7:0)
DRAM.ADD(14:0)
_AC1CS
_AC2CS
Q
NMIP
E
DR.R&_W
ROM AND STATIC RAM
_PFD
PAGE1
PAGE2
PAGE3
PAGE4
PIA AND WATCHDOG
LMP.TST
MAJ.ALRM
MIN.ALRM
40HZ
20HZ
P3600HZ
P600HZ
PWFI
DRPGO
WDG.RESET
P1A-16
P1B-56
P1A-20
P1B-62
IC POWER AND GND
+12V
NEG_12V
+5V
VB+
GND
INTERFACE CIRCUITRY
_RST1
P1A-17
_XE
_XQ
_RSTO
_HCLK
_X288KHZ
_X3600HZ
_X600HZ
_XWFI
XINTF1(4:0)
XINTF2(4:0)
XINTF3(4:0)
3600HZ
288KHZ
600HZ
WFI
DATA BUFFERS AND DRAM
CASCLK
_NMIP
_Q
E.SYNC
_E.SYNC
XNMI
EXT.DATA(7:0)
MASTER OSC AND CLOCK
288KHZ
3600HZ
600HZ
WFI
40HZ
20HZ
POWER CIRCUITRY
B+
P1A-32
P1A-33
P1A-34
P1B-69
P1B-70
P1A-31
P1B-67
P1A-35
P1A-36
P1B-71
P1B-72
P1A-13
P1B-49
TEPS-45815
SHEET 1 OF 9

CURRENT VERSION
SITE CONTROLLER BOARD
MODEL TRN9968A
SCHEMATIC DIAGRAM
DATA BUFFERS & DRAM CIRCUITRY



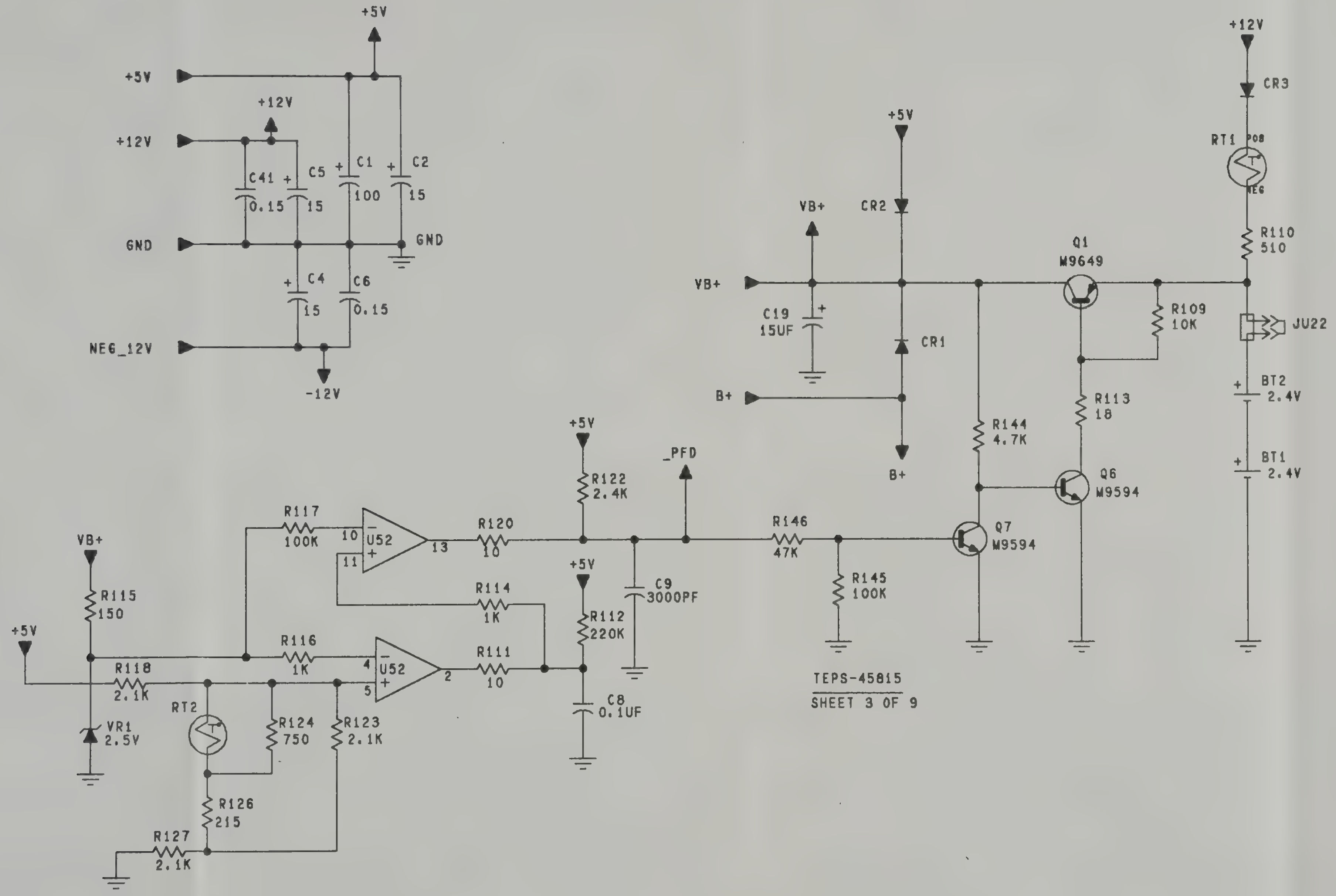
DRPGO
_DRSL
RB_W
_NMIP
_BRAS
_DEC
DR.RB_W
CASCLK
DRAM.ADD(14:0)
_PRE
INT.DATA(7:0)
_E.SYNC
_ADIR
_XEN
_Q
_PFD
E.SYNC
EXT.DATA(7:0)
_NMI
_XNMI
LATCH(3:0)
MUX.ADD(9:0)
RDIR
_OER
_DEC
BRAS
_XEN
U3
U9
U10
U11
U12
U31
U32
U83
U4
U5
U6
U7
U8
U17
U18
U19
U20
JU18
M9528
M9648
CR10
TEPS-45815
SHEET 2 OF 9

CURRENT VERSION
SITE CONTROLLER BOARD
MODEL TRN9968A
SCHEMATIC DIAGRAM
PIA & WATCHDOG TIMER CIRCUITRY


_PFD
_ACTIVE&IDLE
_IRQ
INT.DATA(7:0)
R&_W
E
_RESET
_PCS
PWFI
P600HZ
40HZ
P3600HZ
INT.ADD(15:0)

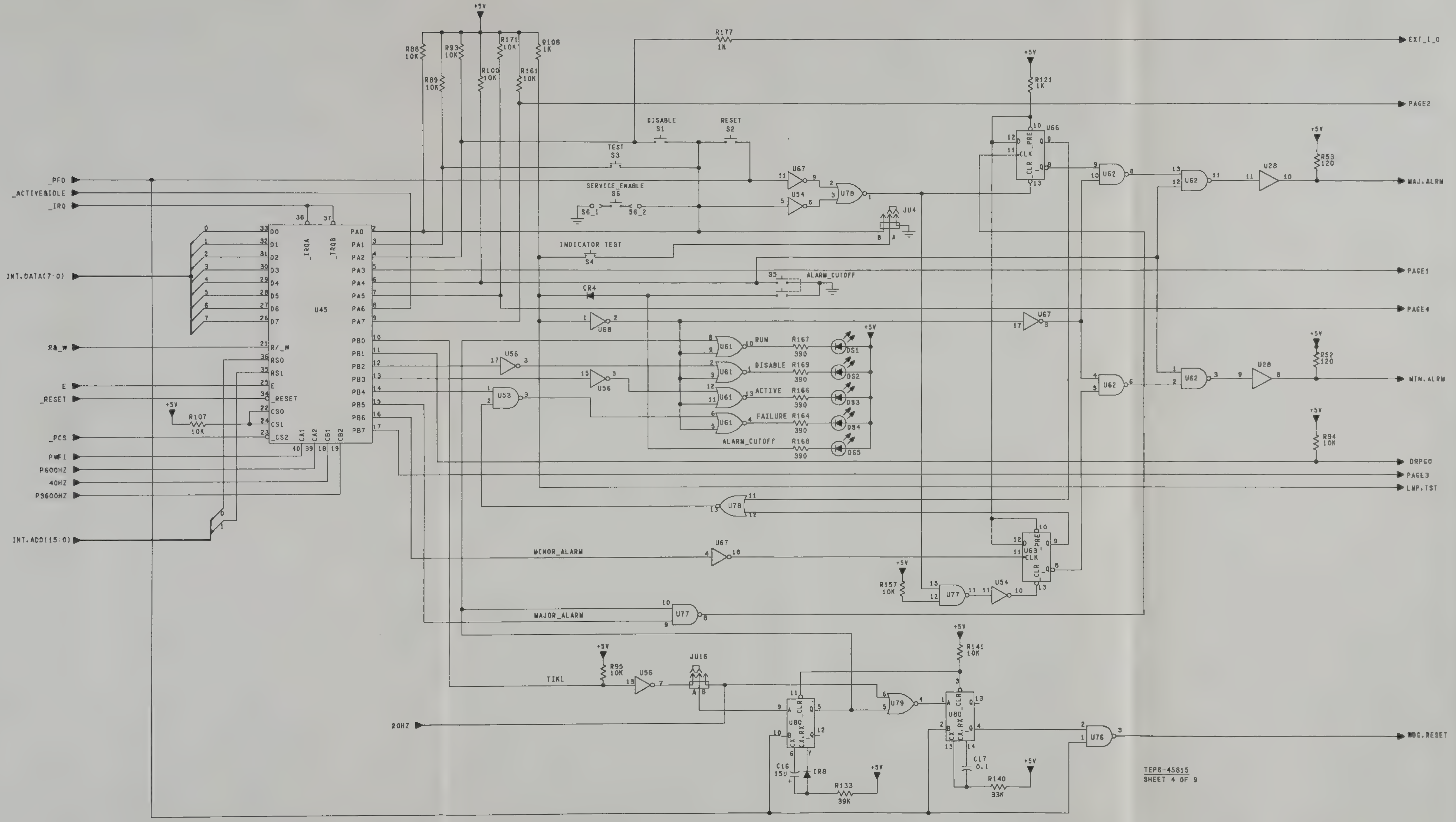
CURRENT VERSION
SITE CONTROLLER BOARD

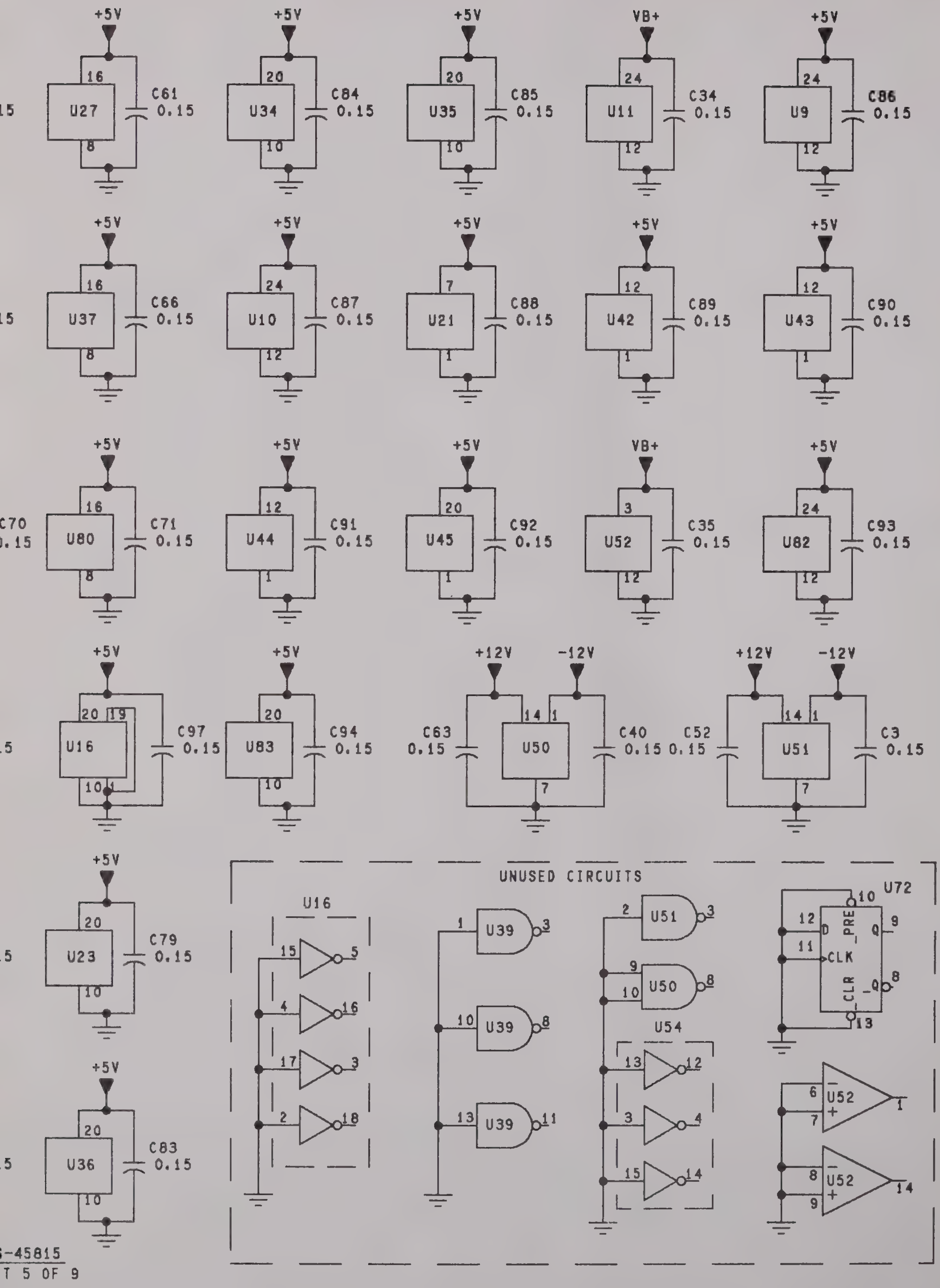
MODEL TRN9968A
SCHEMATIC DIAGRAM
POWER CIRCUITRY


+5V
+5V
+12V
+12V
C41
0.15
C5
15
C1
100
C2
15
GND
GND
C4
15
C6
0.15
NEG_12V
-12V
+5V
VB+
CR2
VB+
C19
15UF
CR1
B+
B+
+12V
CR3
RT1
POS
NEG
R110
510
Q1
M9649
R109
10K
JU22
R113
18
BT2
2.4V
BT1
2.4V
R144
4.7K
Q6
M9594
Q7
M9594
+5V
R122
2.4K
_PFD
R146
47K
R145
100K
C9
3000PF
+5V
R112
220K
C8
0.1UF
R117
100K
U52
10
11
13
R120
10
R114
1K
VB+
R115
150
+5V
R118
2.1K
R116
1K
U52
4
5
2
R111
10
VR1
2.5V
RT2
R124
750
R123
2.1K
R126
215
R127
2.1K
TEPS-45815
SHEET 3 OF 9

CURRENT VERSION
SITE CONTROLLER BOARD

MODEL TRN9968A
SCHEMATIC DIAGRAM
PIA & WATCHDOG TIMER CIRCUITRY


_PFD
_ACTIVE&IDLE
_IRQ
INT.DATA(7:0)
R&_W
E
_RESET
_PCS
PWFI
P600HZ
40HZ
P3600HZ
INT.ADD(15:0)
U45
+5V
R88 10K
R89 10K
R93 10K
R100 10K
R171 10K
R161 10K
R108 1K
R177 1K
R121 1K
R107 10K
DISABLE S1
RESET S2
TEST S3
SERVICE_ENABLE S6
INDICATOR TEST S4
S5 ALARM_CUTOFF
CR4
JU4
U66
U62
U28
U67
U54
U78
U68
U56
U53
U61
RUN R167 390 DS1
DISABLE R169 390 DS2
ACTIVE R166 390 DS3
FAILURE R164 390 DS4
ALARM_CUTOFF R168 390 DS5
R53 120
R52 120
R94 10K
U63
U77
R157 10K
MINOR_ALARM
MAJOR_ALARM
TIKL
R95 10K
JU16
20HZ
U80
U79
U76
C16 15U
CR8
R133 39K
R141 10K
C17 0.1
R140 33K
EXT_I_O
PAGE2
MAJ.ALRM
PAGE1
PAGE4
MIN.ALRM
DRPGO
PAGE3
LMP.TST
WDG.RESET
TEPS-45815
SHEET 4 OF 9

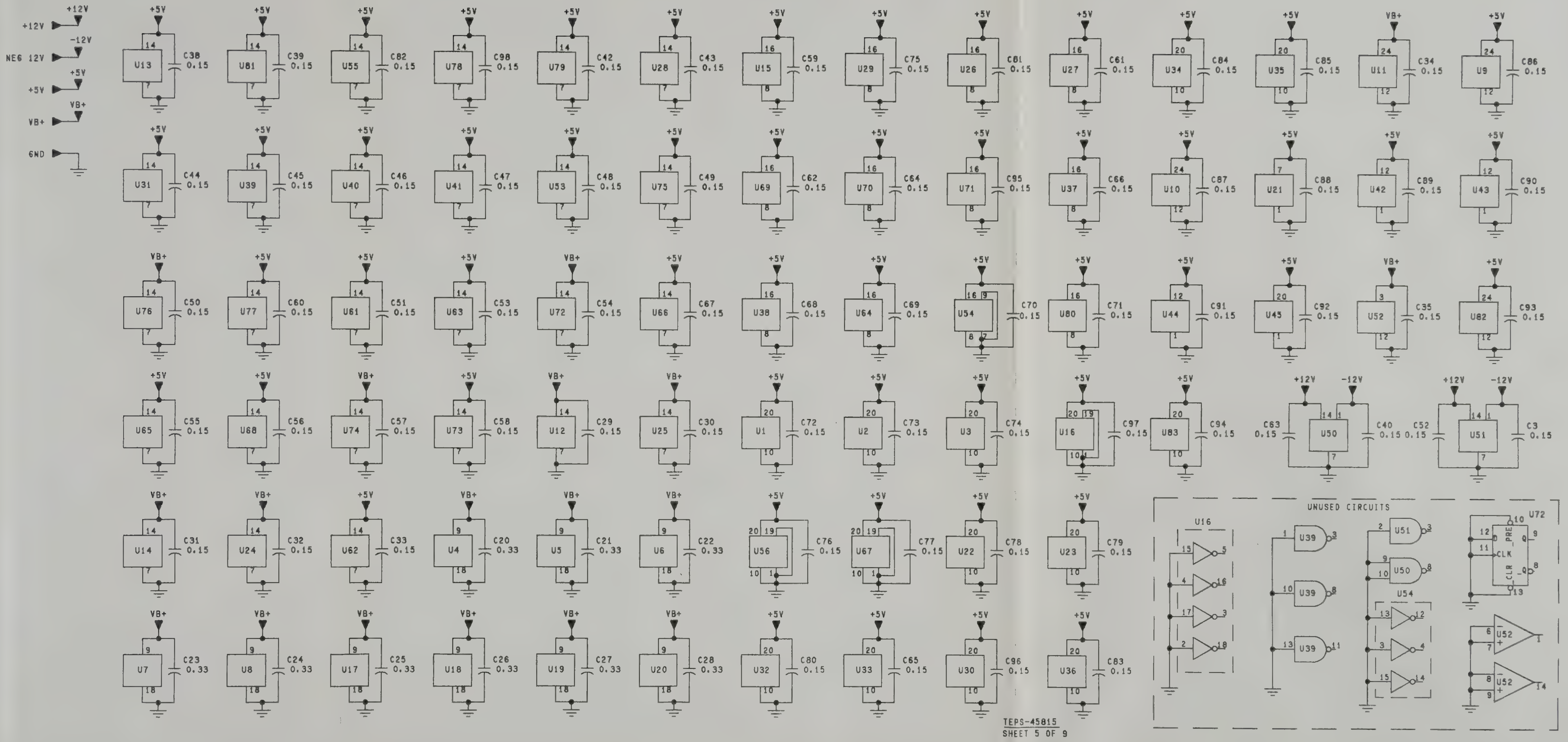

+5V
U27
16
8
C61
0.15
U34
20
10
C84
0.15
U35
C85
0.15
VB+
U11
24
12
C34
0.15
U9
C86
0.15
U37
C66
0.15
U10
C87
0.15
U21
7
1
C88
0.15
U42
C89
0.15
U43
C90
0.15
U80
C70
C71
0.15
U44
C91
0.15
U45
C92
0.15
U52
3
C35
0.15
U82
C93
0.15
U16
19
C97
0.15
U83
C94
0.15
+12V
-12V
U50
14
7
C63
0.15
C40
0.15
U51
C52
0.15
C3
0.15
U23
C79
0.15
U36
C83
0.15
UNUSED CIRCUITS
U16
15
5
4
16
17
3
2
18
U39
1
3
10
8
13
11
U51
2
3
U50
9
10
8
U54
13
12
3
4
15
14
U72
10
12
D
PRE
Q
9
11
CLK
CLR
_Q
8
13
U52
6
7
1
8
9
14
-45815
T 5 OF 9

CURRENT VERSION SITE CONTROLLER BOARD

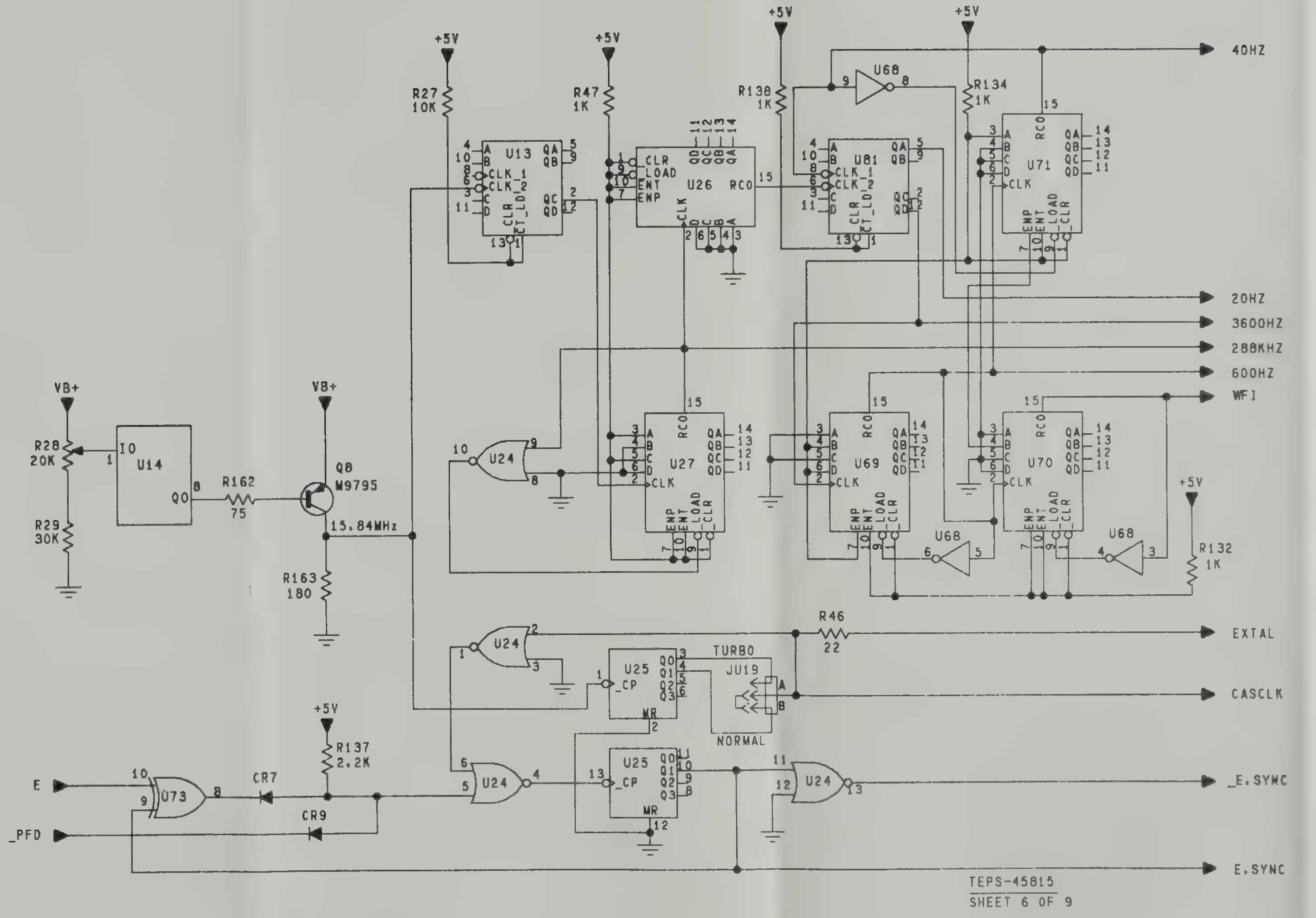
MODEL TRN9968A
SCHEMATIC DIAGRAM
MASTER OSCILLATOR & CLOCK CIRCUITRY

CURRENT VERSION SITE CONTROLLER BOARD

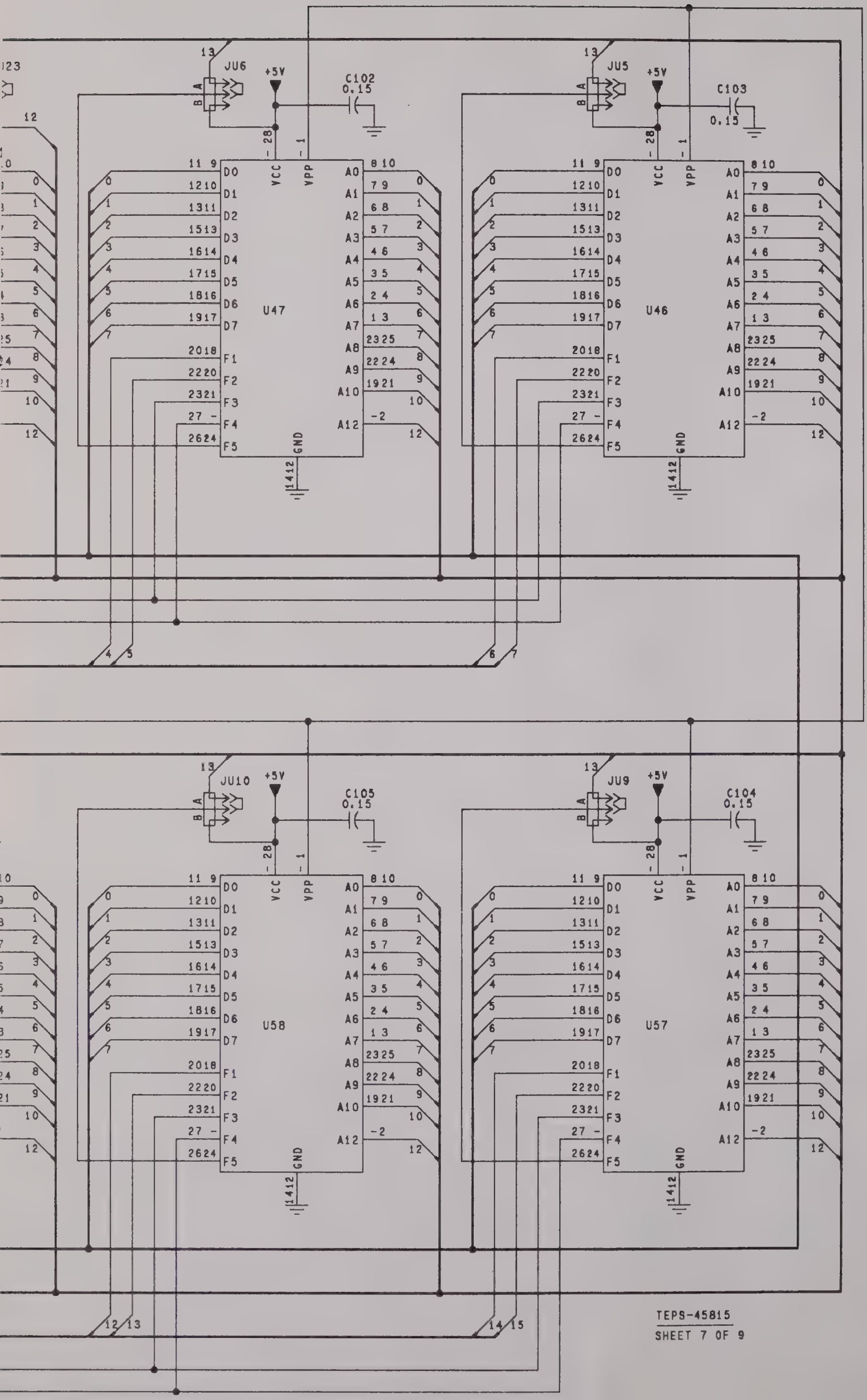
MODEL TRN9968A
SCHEMATIC DIAGRAM
IC POWER & GROUND CIRCUITRY


+12V
NEG 12V
-12V
+5V
VB+
GND
U13 C38 0.15
U81 C39 0.15
U55 C82 0.15
U78 C98 0.15
U79 C42 0.15
U28 C43 0.15
U15 C59 0.15
U29 C75 0.15
U26 C81 0.15
U27 C61 0.15
U34 C84 0.15
U35 C85 0.15
U11 C34 0.15
U9 C86 0.15
U31 C44 0.15
U39 C45 0.15
U40 C46 0.15
U41 C47 0.15
U53 C48 0.15
U75 C49 0.15
U69 C62 0.15
U70 C64 0.15
U71 C95 0.15
U37 C66 0.15
U10 C87 0.15
U21 C88 0.15
U42 C89 0.15
U43 C90 0.15
U76 C50 0.15
U77 C60 0.15
U61 C51 0.15
U63 C53 0.15
U72 C54 0.15
U66 C67 0.15
U38 C68 0.15
U64 C69 0.15
U54 C70 0.15
U80 C71 0.15
U44 C91 0.15
U45 C92 0.15
U52 C35 0.15
U82 C93 0.15
U65 C55 0.15
U68 C56 0.15
U74 C57 0.15
U73 C58 0.15
U12 C29 0.15
U25 C30 0.15
U1 C72 0.15
U2 C73 0.15
U3 C74 0.15
U16 C97 0.15
U83 C94 0.15
C63 0.15 U50 C40 0.15
C52 0.15 U51 C3 0.15
U14 C31 0.15
U24 C32 0.15
U62 C33 0.15
U4 C20 0.33
U5 C21 0.33
U6 C22 0.33
U56 C76 0.15
U67 C77 0.15
U22 C78 0.15
U23 C79 0.15
U7 C23 0.33
U8 C24 0.33
U17 C25 0.33
U18 C26 0.33
U19 C27 0.33
U20 C28 0.33
U32 C80 0.15
U33 C65 0.15
U30 C96 0.15
U36 C83 0.15
UNUSED CIRCUITS
U16
U39
U51
U50
U54
U72
PRE
CLK
CLR
U52
TEPS-45815
SHEET 5 OF 9

CURRENT VERSION
SITE CONTROLLER BOARD
MODEL TRN9968A
SCHEMATIC DIAGRAM
MASTER OSCILLATOR & CLOCK CIRCUITRY

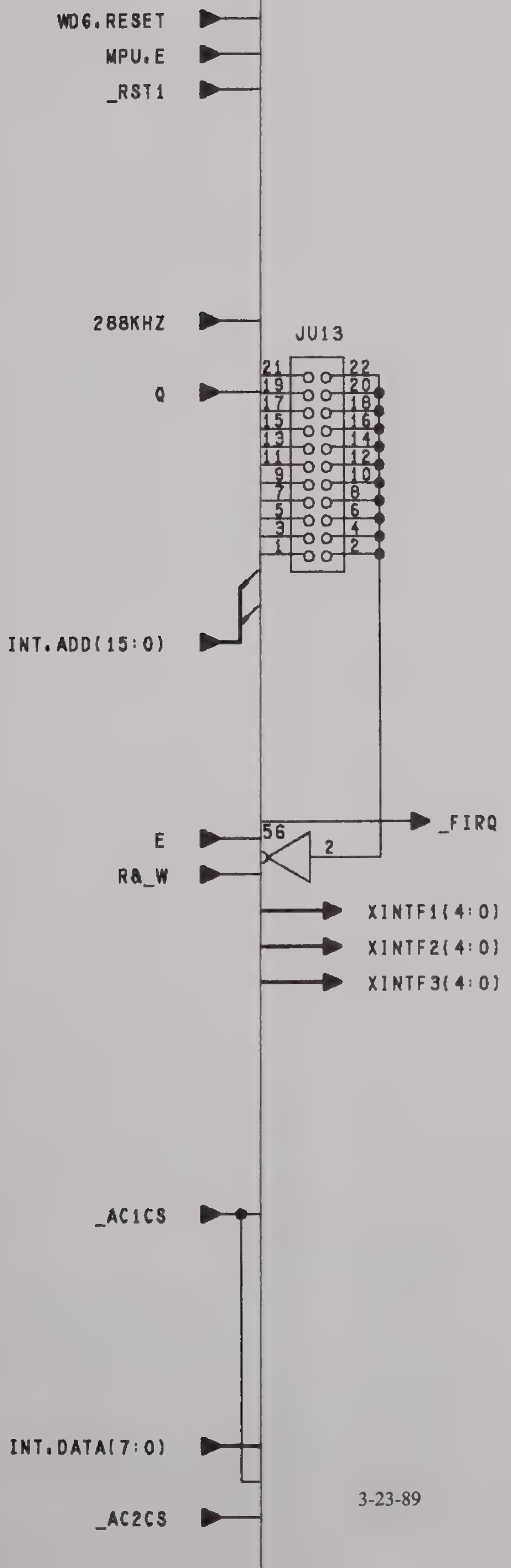


+5V
R27 10K
R47 1K
R130 1K
R134 1K
U13
U26
U81
U71
U68
U27
U69
U70
U24
U14
U25
U73
VB+
R28 20K
R29 30K
R162 75
Q8 M9795
15.84MHz
R163 180
R132 1K
R46 22
R137 2.2K
TURBO
JU19
NORMAL
CR7
CR9
E
_PFD
40HZ
20HZ
3600HZ
288KHZ
600HZ
WFI
EXTAL
CASCLK
_E.SYNC
E.SYNC
TEPS-45815
SHEET 6 OF 9


U47
U46
U58
U57
JU6
JU5
JU10
JU9
C102
0.15
C103
0.15
C105
0.15
C104
0.15
+5V
VCC
VPP
GND
D0
D1
D2
D3
D4
D5
D6
D7
F1
F2
F3
F4
F5
A0
A1
A2
A3
A4
A5
A6
A7
A8
A9
A10
A12
A
B
13
28
1
1412
123

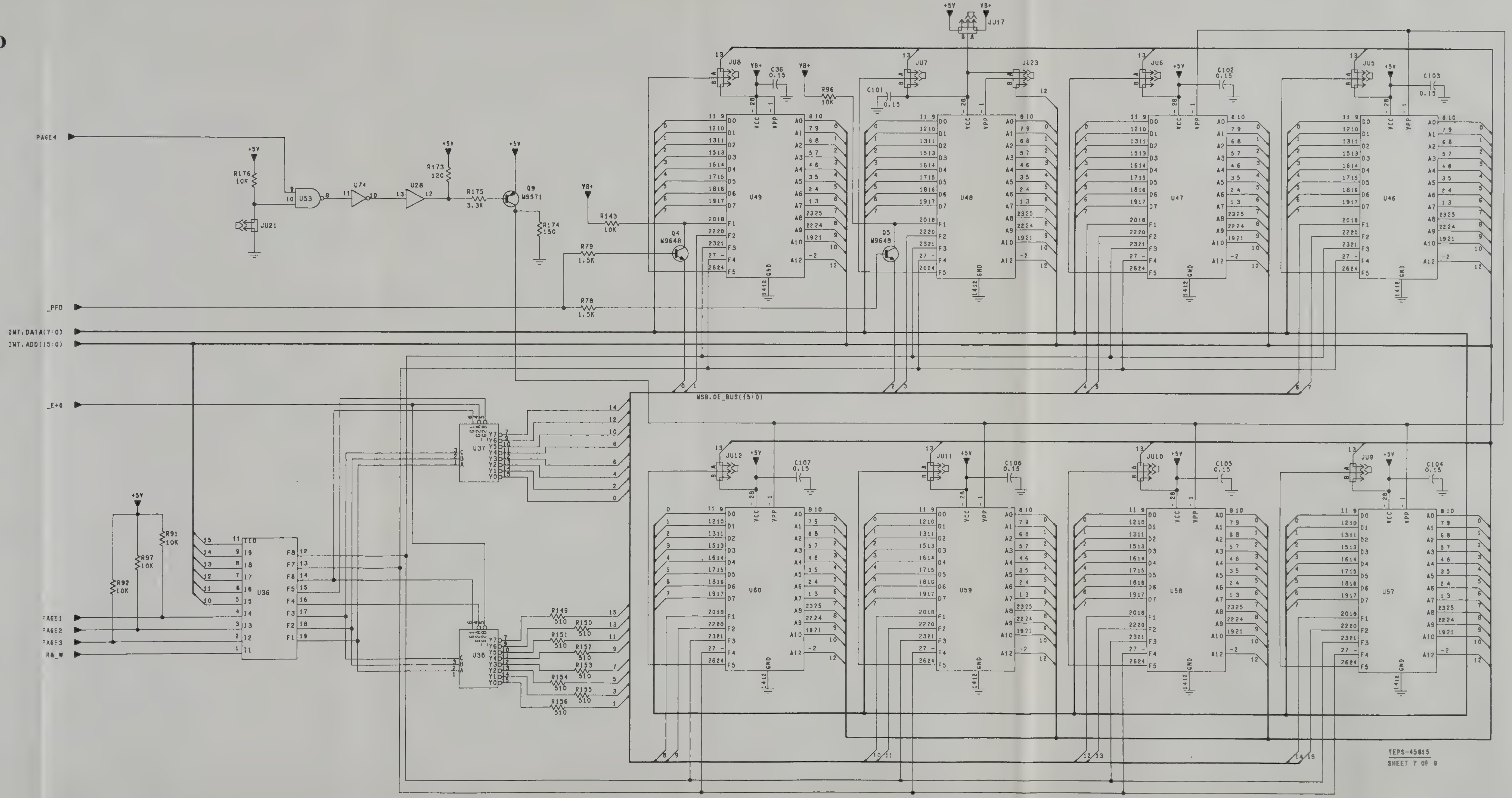
TEPS-45815
SHEET 7 OF 9

CURRENT VERSION
SITE CONTROLLER BOARD
MODEL TRN9968A
SCHEMATIC DIAGRAM
INTERFACE CIRCUITRY


WDG.RESET
MPU.E
_RST1
288KHZ
JU13
21
22
Q
19
20
17
18
15
16
13
14
11
12
9
10
7
8
5
6
3
4
1
2
INT.ADD(15:0)
_FIRQ
E
56
2
R&_W
XINTF1(4:0)
XINTF2(4:0)
XINTF3(4:0)
_AC1CS
INT.DATA(7:0)
_AC2CS

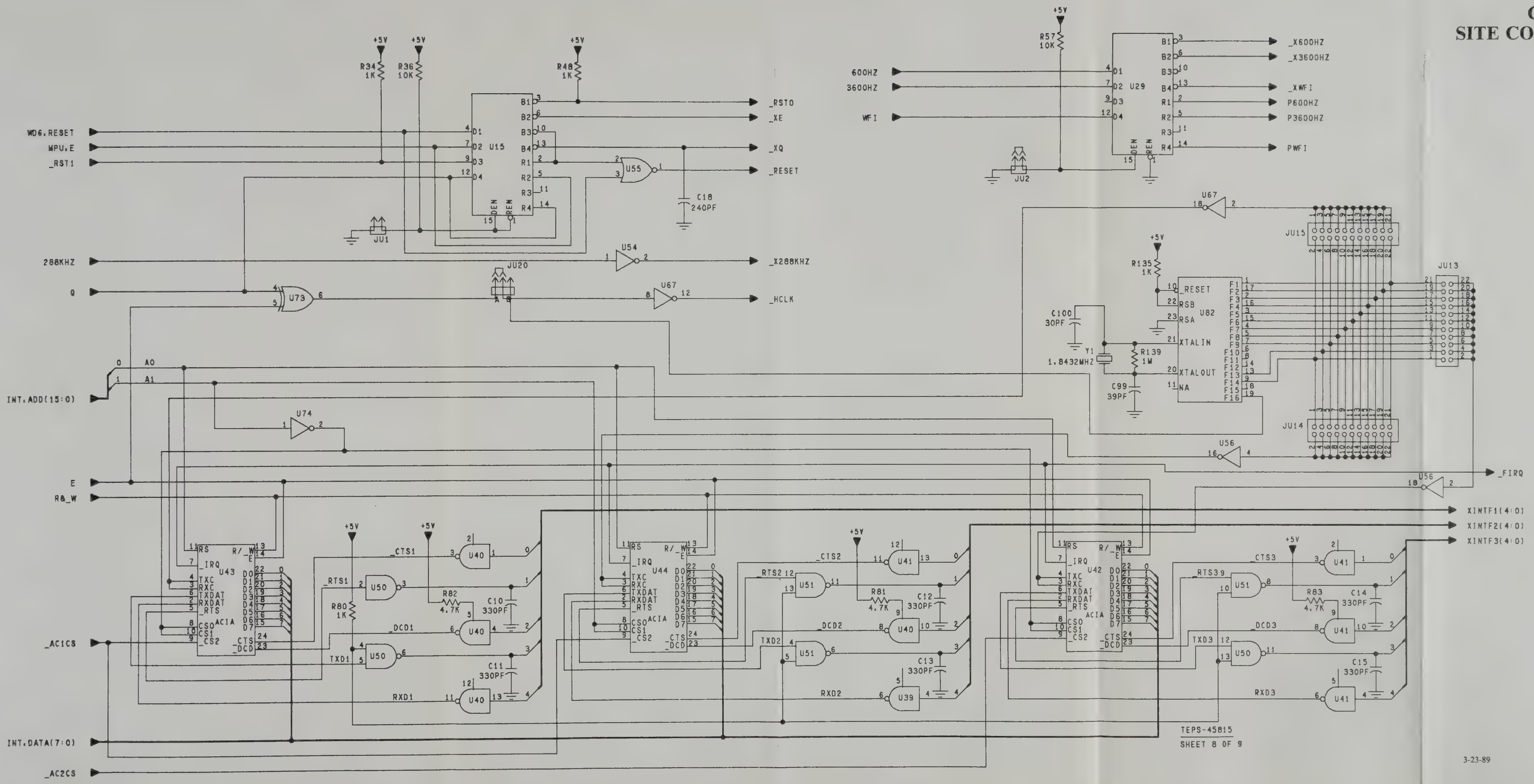
CURRENT VERSION
SITE CONTROLLER BOARD

MODEL TRN9968A
SCHEMATIC DIAGRAM
ROM & STATIC RAM CIRCUITRY

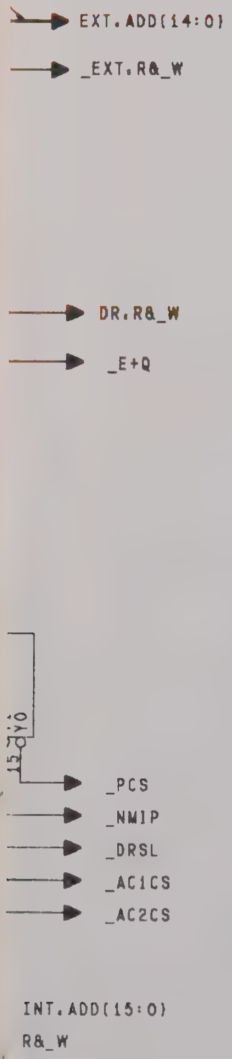

PAGE4
_PFD
INT.DATA(7:0)
INT.ADD(15:0)
_E+Q
PAGE1
PAGE2
PAGE3
R&_W
MSB.OE_BUS(15:0)
R176 10K
JU21
U53
U74
U28
R173 120
R175 3.3K
Q9 M9571
R174 150
R143 10K
R79 1.5K
R78 1.5K
Q4 M9648
Q5 M9648
R96 10K
JU8
JU7
JU23
JU17
JU6
JU5
C36 0.15
C101 0.15
C102 0.15
C103 0.15
U49
U48
U47
U46
JU12
JU11
JU10
JU9
C107 0.15
C106 0.15
C105 0.15
C104 0.15
U60
U59
U58
U57
U37
U38
U36
R91 10K
R97 10K
R92 10K
R149 510
R150 510
R151 510
R152 510
R153 510
R154 510
R155 510
R156 510
+5V
V8+
TEPS-45815
SHEET 7 OF 9

CURRENT VERSION
SITE CONTROLLER BOARD

MODEL TRN9968A
SCHEMATIC DIAGRAM
INTERFACE CIRCUITRY



WDG.RESET
MPU.E
_RST1
288KHZ
Q
INT.ADD(15:0)
E
R&_W
_AC1CS
INT.DATA(7:0)
_AC2CS
+5V
R34 1K
R36 10K
R48 1K
U15
JU1
U55
C18 240PF
U54
U73
JU20
U67
_RST0
_XE
_XQ
_RESET
_X288KHZ
_HCLK
A0
A1
U74
U43
ACIA
U44
U42
U40
U50
U51
U41
U39
_CTS1
_RTS1
_DCD1
TXD1
RXD1
R80 1K
R82 4.7K
C10 330PF
C11 330PF
_CTS2
_RTS2
_DCD2
TXD2
RXD2
R81 4.7K
C12 330PF
C13 330PF
_CTS3
_RTS3
_DCD3
TXD3
RXD3
R83 4.7K
C14 330PF
C15 330PF
600HZ
3600HZ
WFI
R57 10K
U29
JU2
_X600HZ
_X3600HZ
_XWFI
P600HZ
P3600HZ
PWFI
R135 1K
U82
C100 30PF
Y1 1.8432MHZ
R139 1M
C99 39PF
JU15
JU13
JU14
U56
_FIRQ
XINTF1(4:0)
XINTF2(4:0)
XINTF3(4:0)
TEPS-45815
SHEET 8 OF 9


EXT.ADD(14:0)
_EXT.R&_W
DR.R&_W
_E+Q
15
Y0
_PCS
_NMIP
_DRSL
_AC1CS
_AC2CS
INT.ADD(15:0)
R&_W

MOTOROLA INC.
Communications
Sector

INBOUND RECOVERY BOARD MODULE

MODEL TRN8662B

1. INTRODUCTION

The TRN8662B Inbound Recovery Board (IRB) module interfaces with four Motorola Trunked Radio System Base repeaters and serves to decode data from one of base repeater station receivers. It contains three signal-processing subsystems — a high-speed analog-to-digital converter, bit synchronism recovery circuitry, and memory buffers. The IRB, in conjunction with the receiver site controller (RSC), processes the 78 bit inbound signal word (ISW). The ISW data is sent to the IRB in synchronism with the system clock known as the word frame interrupt (WFI). Propagation delay can cause a 0-to-3-bit uncertainty in the arrival time of the ISW data. Another source of uncertainty is the center frequency offset of the received data. The RSC software enables the IRB to remove these uncertainties while it is converting the received audio into digital data.

2. FUNCTIONAL DESCRIPTION

2.1 ADDRESS DECODING

2.1.1 The IRB contains three sections that are addressable through the RSC: the PIA, analog-to-digital converter, and buffer memory. The address decoding for the three sections is performed by U23, U24, and several gates of U14, U15, and U26. Address lines $\overline{A11}$ through $\overline{A15}$ and control signal VMA are inverted by U13A through U13F. U23 decodes A8, A11, A12, A14, A15, and VMA into four control signals: $\overline{PIA}$, $\overline{LM}$, $\overline{HM}$, and $\overline{A/D}$. Control signal $\overline{PIA}$ is valid whenever the address is within the range of \$9800-\$9803, and is used as a chip select for PIA U37. Control signals $\overline{LM}$ and $\overline{HM}$ are OR'd by U15 and the output at U15-3 is valid whenever the address is within the range of \$9000-\$91FF. U24 decodes the signals A/D, B/$\overline{A}$, and Ø2, as well as the OR'd signal from U15-3, and provides two control signals: $\overline{R/EA}$ (U24-5) and $\overline{R/EB}$ (U24-4). The two control signals are used to enable data multiplexer receivers U11, U12, and U21, and U22.

2.1.2 Two more control signals are generated: D/EO, the data bus driver control signal, and $\overline{R/EO}$, the data bus receiver control signal. U14A generates D/EO at its output (pin 6) by ANDing Ø2, A15, $\overline{A14}$, $\overline{A13}$, A12, VMA and R/$\overline{W}$. U15B generates the second control signal, $\overline{R/EO}$, by ANDing R/$\overline{W}$ and Ø2. D/EO and $\overline{R/EO}$ determine the direction of the data on the internal bidirectional data bus.

2.2 INPUT MULTIPLEXER

The base repeater #1 discriminator is connected to the IRB via edge connectors 63 (DISC1) and 27 (RRET1). The discriminators for repeaters #2, 3, and 4 are connected via connectors 62-26 (DISC2-RRET2), 61-25 (DISC3-RRET3), and 60-24 (DISC4-RRET4), respectively. The signal pairs are routed to the inputs of Multiplexer U25 (4-11, 2-15, 5-14, and 1-12, respectively). U25 selects one of the four signal pairs and provides an output at pins 13 and 3; operational amplifier U46D converts the signal pair into a single-ended signal. This signal (U46D-14) proceeds to the low-pass filter and squelch circuits. Discriminator selection is under software control, and this has been achieved by putting it under control of bits 1-3 (PB1-PB3) on the B side of U37 (pins 11, 12, and 13, respectively).

2.3 LOW-PASS FILTER

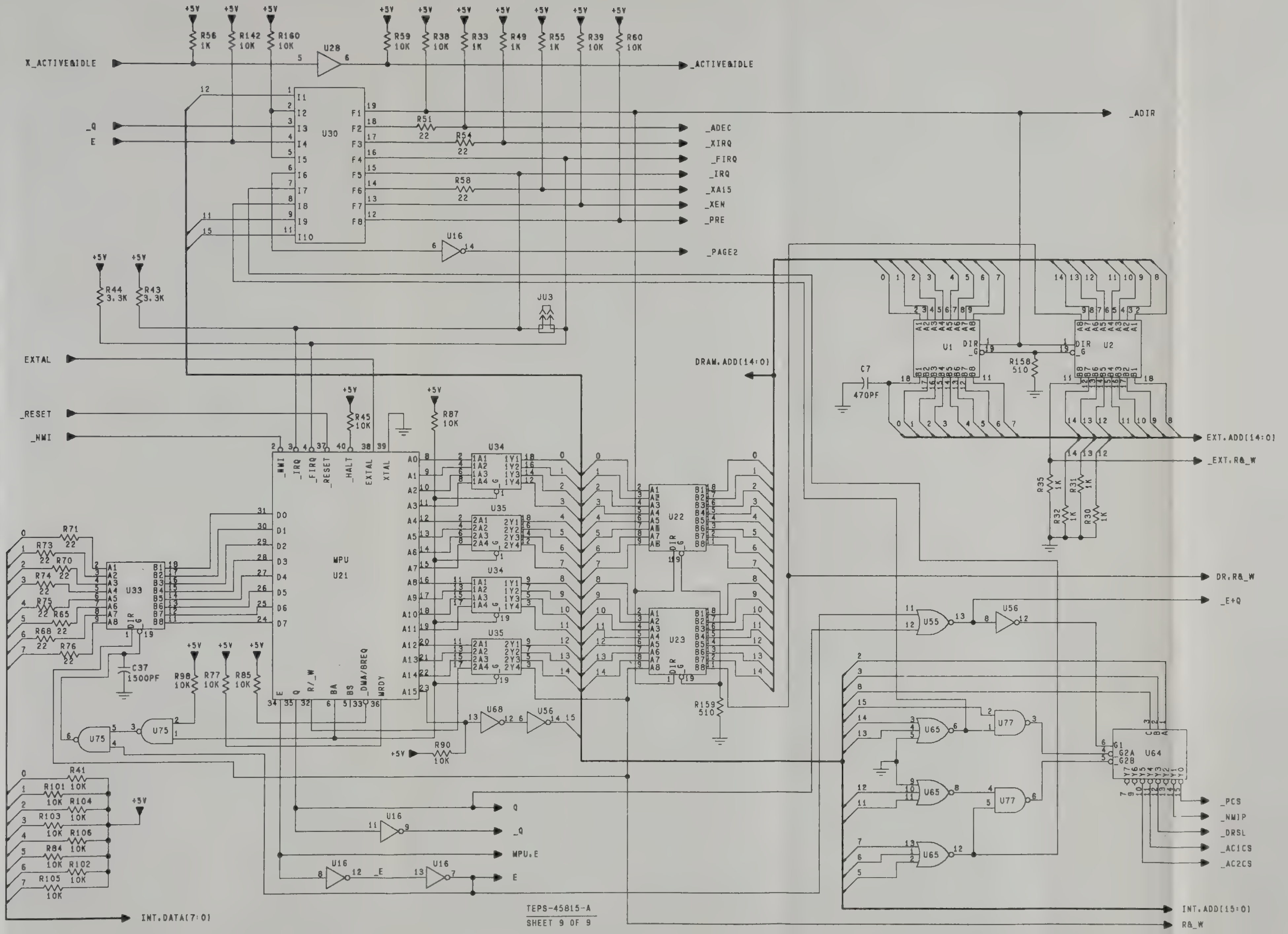
The output of the input multiplexer is routed to a low-pass filter consisting of operational amplifiers U46B, U33A, and U33B, and associated components. The filter is used to remove high-frequency noise from the data word. It is a 7-pole Bessel filter with a 3 dB rolloff at 2.2 kHz. Because of its linear phase characteristics through the passband, the Bessel filter is required to reduce inter-symbol interference that may result from non-linear phase response. The low-pass filter output is connected to the DATA line (pin 13) of analog-to-digital multiplexer U61 as well as to the inverting input (pin 2) of the BIT SYNC circuit, U27A.

2.4 SYNCHRONOUS SQUELCH CIRCUIT

The synchronous squelch circuit consists of operational amplifiers U46A and U46C, analog gate U54B, and associated components. The squelch circuit contains a 3-pole high-pass filter followed by a diode rectifier (CR9)

CURRENT VERSION
SITE CONTROLLER BOARD

MODEL TRN9968A
SCHEMATIC DIAGRAM
MPU CIRCUITRY


X_ACTIVE&IDLE
_ACTIVE&IDLE
_ADIR
_Q
E
U30
_ADEC
_XIRQ
_FIRQ
_IRQ
_XA15
_XEN
_PRE
_PAGE2
U28
U16
JU3
EXTAL
_RESET
_NMI
DRAM.ADD(14:0)
MPU
U21
U33
U34
U35
U22
U23
U1
U2
C7
470PF
R158
510
EXT.ADD(14:0)
_EXT.R&_W
DR.R&_W
_E+Q
U55
U56
U65
U77
U64
_PCS
_NMIP
_DRSL
_AC1CS
_AC2CS
INT.ADD(15:0)
R&_W
INT.DATA(7:0)
Q
_Q
MPU.E
E
U68
U75
C37
1500PF
R159
510
TEPS-45815-A
SHEET 9 OF 9

MOTOROLA INC.
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INBOUND RECOVERY BOARD MODULE

MODEL TRN8662B

1. INTRODUCTION

The TRN8662B Inbound Recovery Board (IRB) module interfaces with four Motorola Trunked Radio System Base repeaters and serves to decode data from one of base repeater station receivers. It contains three signal-processing subsystems — a high-speed analog-to-digital converter, bit synchronism recovery circuitry, and memory buffers. The IRB, in conjunction with the receiver site controller (RSC), processes the 78 bit inbound signal word (ISW). The ISW data is sent to the IRB in synchronism with the system clock known as the word frame interrupt (WFI). Propagation delay can cause a 0-to-3-bit uncertainty in the arrival time of the ISW data. Another source of uncertainty is the center frequency offset of the received data. The RSC software enables the IRB to remove these uncertainties while it is converting the received audio into digital data.

2. FUNCTIONAL DESCRIPTION

2.1 ADDRESS DECODING

2.1.1 The IRB contains three sections that are addressable through the RSC: the PIA, analog-to-digital converter, and buffer memory. The address decoding for the three sections is performed by U23, U24, and several gates of U14, U15, and U26. Address lines $\overline{A11}$ through A15 and control signal VMA are inverted by U13A through U13F. U23 decodes A8, A11, A12, A14, A15, and VMA into four control signals: PIA, LM, HM, and A/D. Control signal $\overline{PIA}$ is valid whenever the address is within the range of \$9800-\$9803, and is used as a chip select for PIA U37. Control signals $\overline{LM}$ and $\overline{HM}$ are OR'd by U15 and the output at U15-3 is valid whenever the address is within the range of \$9000-\$91FF. U24 decodes the signals A/D, B/$\overline{A}$, and Ø2, as well as the OR'd signal from U15-3, and provides two control signals: $\overline{R/EA}$ (U24-5) and $\overline{R/EB}$ (U24-4). The two control signals are used to enable data multiplexer receivers U11, U12, and U21, and U22.

2.1.2 Two more control signals are generated: D/EO, the data bus driver control signal, and $\overline{R/EO}$, the data bus receiver control signal. U14A generates D/EO at its output (pin 6) by ANDing Ø2, A15, $\overline{A14}$, $\overline{A13}$, A12, VMA and R/W. U15B generates the second control signal, $\overline{R/EO}$, by ANDing R/$\overline{W}$ and Ø2. D/EO and $\overline{R/EO}$ determine the direction of the data on the internal bidirectional data bus.

2.2 INPUT MULTIPLEXER

The base repeater #1 discriminator is connected to the IRB via edge connectors 63 (DISC1) and 27 (RRET1). The discriminators for repeaters #2, 3, and 4 are connected via connectors 62-26 (DISC2-RRET2), 61-25 (DISC3-RRET3), and 60-24 (DISC4-RRET4), respectively. The signal pairs are routed to the inputs of Multiplexer U25 (4-11, 2-15, 5-14, and 1-12, respectively). U25 selects one of the four signal pairs and provides an output at pins 13 and 3; operational amplifier U46D converts the signal pair into a single-ended signal. This signal (U46D-14) proceeds to the low-pass filter and squelch circuits. Discriminator selection is under software control, and this has been achieved by putting it under control of bits 1-3 (PB1-PB3) on the B side of U37 (pins 11, 12, and 13, respectively).

2.3 LOW-PASS FILTER

The output of the input multiplexer is routed to a low-pass filter consisting of operational amplifiers U46B, U33A, and U33B, and associated components. The filter is used to remove high-frequency noise from the data word. It is a 7-pole Bessel filter with a 3 dB rolloff at 2.2 kHz. Because of its linear phase characteristics through the passband, the Bessel filter is required to reduce inter-symbol interference that may result from non-linear phase response. The low-pass filter output is connected to the DATA line (pin 13) of analog-to-digital multiplexer U61 as well as to the inverting input (pin 2) of the BIT SYNC circuit, U27A.

2.4 SYNCHRONOUS SQUELCH CIRCUIT

The synchronous squelch circuit consists of operational amplifiers U46A and U46C, analog gate U54B, and associated components. The squelch circuit contains a 3-pole high-pass filter followed by a diode rectifier (CR9) and an integrator. The high-pass filter has a 3 dB rolloff at 5.5 kHz. CR9, U54B, and the integrator form an integrate-and-dump circuit that integrates the high-pass filter output from U46C-8 for 23 milliseconds and provides an output at U46A-1. This output is routed to the SQUELCH input (pin 14) of multiplexer U61.

2.5 ANALOG-TO-DIGITAL MULTIPLEXER

The analog-to-digital multiplexer consists of U61, operational amplifier U27B, gates U31D, U31E, and U31F, and associated components. U61 selects one of seven inputs (DATA, SQUELCH, BS1 through BS5) and provides an A/D output on pin 3. Input selection is controlled by PB4, PB5, and PB6 (pins 14, 15, and 16, respectively) on the B side of PIA U37. The A/D output of the multiplexer is buffered by U27B and provided on U27B-7.

2.6 CONTROL CHANNEL SELECTOR

The control channel selector decodes bits PA0 and PA1 from PIA U37 into one of four open-collector signals that are supplied to the four base repeaters. Opto-isolators U5 through U8 are employed to provide the required TTL-to-open-collector interface. The decoder enable signal (U45A-1) is directly controlled by bit PB0 from U37. The base repeater uses the control signals to select between the IRB and RIB discriminator interface.

2.7 ADDRESS COUNTERS

The address counters (U47, U48, and U49) receive the 18 kHz clock pulses generated at U42-3 and produce nine address signals (A0BF-A8BF) that are routed to the address multiplexer (U20, U28, U34, U40, and U41). These address lines are used to forward sampled data from the A/D converter to sequential memory locations. U49 is used as a divide-by-two counter, while U47 and U48 are used as down counters. When counting reaches zero, the borrow output at U47-13 goes low indicating that the last sample is received. The BSD signal on U59-9 presets the counters to $195 (405 decimal).

2.8 T_0 COUNTER

2.8.1 The T_0 counter, consisting of binary up/down counters U56 and U57 and flip-flops U58A and U58B, determines when the IRB sampling action starts relative to the WFI. U56 and U57 are connected as down counters, with U56 being the least significant counter and U57 the most significant. Each counter is provided with 4 preset inputs, and the 8 preset inputs to the counters represent the number of the 18 kHz clock periods the IRB delays before the sampling of the A/D converter output starts.

2.8.2 The counters can be preset from $00 to $FF by changing the jumper located in the upper left corner of the board. This allows delays of 0 ms to 14.2 ms, respectively. The most significant bit (MSB) is the lower right jumper, the least significant bit (LSB) is the upper left jumper. A jumper on the upper two pins of each block inputs a logic "1", while a jumper on the two lower pins inputs a logic "0". A change in the LSB causes a change in delay of 55.6 microseconds. The jumpers are preset to $F6 (13.68 ms) at the factory. While counting down from the preset value to 0, U56 and U57 provide a borrow output at U57-13. This signal toggles U58A and the $\overline{Q}$ output at U58A-5 generates a disable signal that is routed to pin 12 of AND gate U42D. The Q output at U58A-5 toggles U58B, and the Q output at U58B-9 provides a disable signal that is routed to pin 1 of the NAND gate U42A.

2.8.3 U56 and U57 are preset and U58A is cleared when a synchronized WFI signal is received from U43B-8 (TOL). Upon clearing U58A, the disable signal is removed from U42D-12, thus allowing the 18 kHz clock to be routed to counters U56 and U57. Also, whenever the $\overline{405}$ signal at U58B-13 goes low, the disable signal is removed from U42A-1, thus allowing the 18 kHz clock to be routed to the address counters at U49-11.

2.9 ANALOG-TO-DIGITAL CONVERTER

2.9.1 The A/D converter receives the buffered output from U27B-7 and converts it into an 8-bit word that is presented on the outputs of counters U16 and U18. U16 represents the least significant bits, and U18 represents the most significant. The 921.6 kHz A/D clock (Ø2) is generated by the RSC. This clock enters the IRB at pin 51, is buffered by U4, and routed to U4-12.

2.9.2 Whenever comparator U19 detects that the current from U17-4 is less than the current through R73 (which is the current caused by the analog input), a high logic level is presented to the D input (pin 2) of flip-flop U9. Clocked by the 1.8432 MHz system clock, U9 generates an output at pin 5 that controls the up/down direction of U16 and U18. The carry output at U18-15 is fed back as an inhibit control signal to U16 and U18 to prevent the two counters from counting to full scale and from rolling over to 0 when the input signal is larger than $FF.

2.9.3 Bit 7 (PB7) on the B side of PIA U37 is connected as a load ($\overline{L}$) signal to counters U16 and U18 (pins 9). Moreover, PB7 is used as a clock that causes D flip-flop U9B to toggle. When PB7 goes low, a $7F or $80 is loaded into counters U16 and U18. This feature centers the A/D converter to half scale; it also provides a means of testing the A/D converter.

2.10 BIT SYNC

2.10.1 The bit sync is recovered from the encoded audio signal by a combination of linear and non-linear processing. The signal, received from the low-pass filter output (U33B-7), is first filtered by a band-pass filter consisting of U27A, U27C, and U27D. The output at U27A-1 is then routed to a high-speed, full-wave rectifier (U33C and U33D) and associated components. The rectifier converts a waveform that is phase-coherent to half the bit rate to a waveform that is phase-coherent to exactly the bit rate. The rectifier output at U33D-14 is synchronously sampled at 5 times the bit rate by a circuit consisting of divide-by-five counter U38 and analog multiplexer U62 as well as other associated gates.

2.10.2 Capacitor C16 through C20, activating as correlators, receive 405 samples each bit time, with each capacitor receiving 81 samples. The capacitor with the largest charge at the end of the word time indicates which of the 5 segments of the bit interval is closest to the bit interval center. Since each capacitor is directly connected to an input of A/D multiplexer U61, the RSC is capable of examining the five capacitor values and determining the bit center within an accuracy of ±10%.

2.11 BUFFERS AND MULTIPLEXERS

2.11.1 The IRB uses a double memory buffer that allows storage of data while the RSC is processing the old data. Synchronization of processing to the data word time ensures that the data being stored for one word is completely contained in one buffer before this buffer is switched over to the RSC for processing. Processing of data from any buffer occurs during one word time to avoid overwriting of the buffer by new data.

The data buffer and multiplexer consists of:

- data multiplexer
- memory buffer A
- memory buffer B
- address multiplexer

2.11.2 The data multiplexer, consisting of U11, U12, U21, and U22, serves two purposes: (1) it routes data from the A/D converter to a memory buffer, and (2) it routes data from a memory buffer to the RSC.

2.11.3 Control signal B/$\overline{A}$, generated at U44B-9, is used to swap the memory buffers between the RSC and the A/D converter output. When B/$\overline{A}$ is high, the U12 and U22 drivers are enabled, causing the A/D converter output to be sent to memory buffer A (U36). When B/$\overline{A}$ is low, the drivers are disabled and the A/D converter output is disconnected from memory buffer A. U11 and U21 forward data to memory buffer B exactly as U12 and U22 presented data to memory buffer A. U11 and U21, however, are controlled by control signal B/$\overline{A}$ generated at the $\overline{Q}$ output (pin 8) of U44B. B/$\overline{A}$ toggles once every 23 milliseconds, causing the A/D converter output data to alternate between the two memory buffers at the same rate.

2.11.4 The RSC reads data either from the A/D converter or data that was stored in a memory buffer one word time earlier. When the RSC reads memory location \$9900, the address decode section provides two signals: $\overline{R/E_A}$ (at U24-5) and $\overline{R/E_B}$ (at U24-4). For a data read from the A/D converter, one of the following conditions should be true:

- $\overline{R/E_B}$ = B/$\overline{A}$ = L (low)
- $\overline{R/E_A}$ = L & B/$\overline{A}$ = H (high)

2.11.5 The RSC can access any of the 405 data samples stored in the IRB by reading the corresponding memory locations \$9000 to \$9195 (inclusive).

2.11.6 Memory buffer A (U36) and memory buffer B (U35), each use \$195 bytes of 2k × 8 bit static RAMs. The address multiplexer (U20, U28, U34, U40, and U41), which controls the addressing for each memory buffer, determines whether a memory buffer is connected to the RSC address lines or to the IRB address counter. When memory buffer A is connected to the RSC address lines, memory buffer B is connected to the address counter—and vice versa.

2.12 CONTROL SECTION

2.12.1 The control section consists of U42, U43, U44, U49, U50, U51, U55, U59, and associated components. The $\overline{MR}$ (master reset) signal, which enters the board at edge connector pin 14 and is buffered by inverters U10E and U50E, resets PIA U37 as well as D flip-flops U59A and U59B; it also sets flip-flop U58A.

2.12.2 Clock signal $\overline{288}$ kHz enters the board at edge connector pin 53, is inverted by U10D, and then divided by 16 by U55 to generate an 18 kHz signal at U55-11. The 18 kHz signal is routed to one input (pin 2) of NAND gate U42A. SE (sample clock enable), generated at U58B-9, is routed to the other input (pin 1) of the NAND gate. The NAND gate produces an SC (sample clock) signal at U42A-3 which is routed to U49-11 and U38-2 to clock both the address counters (U47, U48, and U49) and the bit sync counter (U38). Moreover, the 18 kHz signal at U55-11 is also routed to D flip-flop U43B (pin 11) and to inverter U50D (pin 9). The $\overline{18}$ kHz signal output at U50D-8 is routed to an input (pin 13) of NAND gate U42D. TOE (To Clock Enable) from U58A-6 is routed to the second input (pin 12) of U42D. The output at U42D-11 is the T_0 counter clock signal (TOC).

2.12.3 The $\overline{WFI}$ (word frame interrupt) clock signal enters the board at edge connector pin 54. It is inverted by U10F and then routed to the clock input (pin 3) of D flip-flop U43A. Flip-flops U43A and U43B are connected to synchronize $\overline{WFI}$ to the 18 kHz clock. The synchronized signal $\overline{TOL}$ is presented at U43B-8, and causes the T_0 counter to be set and started.

2.12.4 The borrow output at U47-13 goes low at the 405th data sample. This signal is routed to the D input (pin 2) of flip-flop U59A, and this flip-flop generates a $\overline{405}$ signal at pin 5. The $\overline{405}$ signal, which is synchronized to the 18 kHz clock, is routed to U59B-12. U59B generates a BSD signal at pin 9 which is routed to U47-11, U48-11, and U49-10 to set the three address counters. The BSD signal is also routed to U63A-1 to clear the bit sync dump flip-flop (U63A). The $\overline{405}$ signal from U59A-5 is routed to U44B-11 and is used to toggle this flip-flop at each 405. U44B generates a B/$\overline{\text{A}}$ signal at pin 9 and its complement ($\overline{\text{B/A}}$) at pin 8.

2.12.5 The memory buffer write signal $\overline{\text{WBF}}$ is generated by U51A, U51B, and U44A and is presented at U51B-8. This signal, which is routed to U41-10 and U41-14 where it is multiplexed by the address multiplexer, causes a write operation in the memory buffer connected to the address counters.

2.13 FRONT PANEL LED INDICATORS

2.13.1 The front panel of the IRB is provided with the following seven LED indicators:

- DS4 through DS7, green color, CONTROL CHANNEL indicators
- DS3, green, DECODE indicator
- DS2, green, UNSQUELCH indicator
- DS1, red, FAILURE indicator

2.13.2 The PB1 and PB2 signals from pins 11 and 12, respectively, on PIA U37 are decoded into 1-of-4 signals that drive DS4 through DS7. PA4 from U37-6 controls the enable signal on pin 15 of U45, the decoder for the channel indicators. DS3, the DECODE indicator, is controlled by PA7 from U37-9, PA6 from U37-8 controls the UNSQUELCH indicator, DS2. The red FAILURE indicator is controlled by PA5 (U37-7).

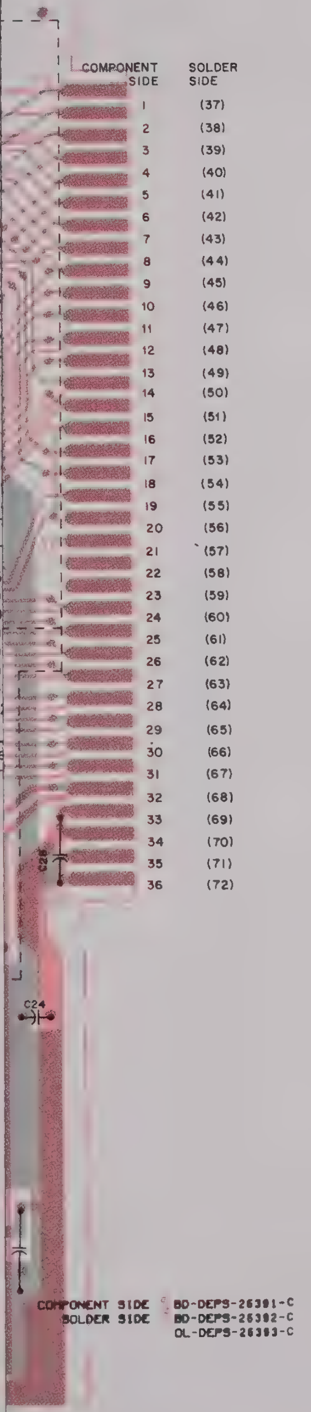
2.13.3 During normal operation, all indicators are under software control. A lamp test signal, LPTST, is provided on pin 16 of the edge connector. When low, this signal causes all the LEDs to turn on.

REFERENCE SYMBOL	MOTORO PART N
U17	51-82609M
U18	51-84561L5
U19	51-82609M
U20	51-84561L4
U21, 22	51-84371K7
U23	51-84561L4
U24	51-84561L4
U25	51-82884L5
U26	51-84561L0
U27	51-84561L7
U28	51-84561L4
U31	51-84371K0
U32	51-84371K0
U33	51-84561L7
U34	51-84561L4
U35, 36	51-83625M
U37	51-84561L3
U38	51-84561L4
U39	51-84371K0
U40, 41	51-84561L4
U42	51-84561L0
U43, 44	51-84561L3
U45	51-84561L4
U46	51-82760P1
U47, 48	51-84561L3
U49	51-84561L3
U50	51-84561L0
U51	51-84561L3
U52	51-84561L4
U53, 54	51-82884L1
U55	51-84561L4
U56, 57	51-84561L3
U58, 59	51-84561L3
U60	51-84561L4
U61, 62	51-82884L4
U63	51-84561L3
	3-136890
	9-83469K05
	22-84986F0
	55-82239K0
	41-84891F0
	42-84837F0
	61-84989F0
	64-84680F0
	28-84729L0
	9-84181L01

e: For optimum performance
ordered by Motorola part nu

TRN8662B INBOUND RECOVERY BOARD

BLOCK DIAGRAM, CIRCUIT BOARD DETAIL, LOGIC DIAGRAM, AND PARTS LIST


COMPONENT SIDE
SOLDER SIDE
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2 (38)
3 (39)
4 (40)
5 (41)
6 (42)
7 (43)
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33 (69)
34 (70)
35 (71)
36 (72)
C26
C24
COMPONENT SIDE BD-DEPS-26301-C
SOLDER SIDE BD-DEPS-26302-C
OL-DEPS-26303-C

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2.13 FRONT PANEL LED INDICATORS

2.13.1 The front panel of the IRB is provided with the following seven LED indicators:

- DS4 through DS7, green color, CONTROL CHANNEL indicators

- DS3, green, DECODE indicator

- DS2, green, UNSQUELCH indicator

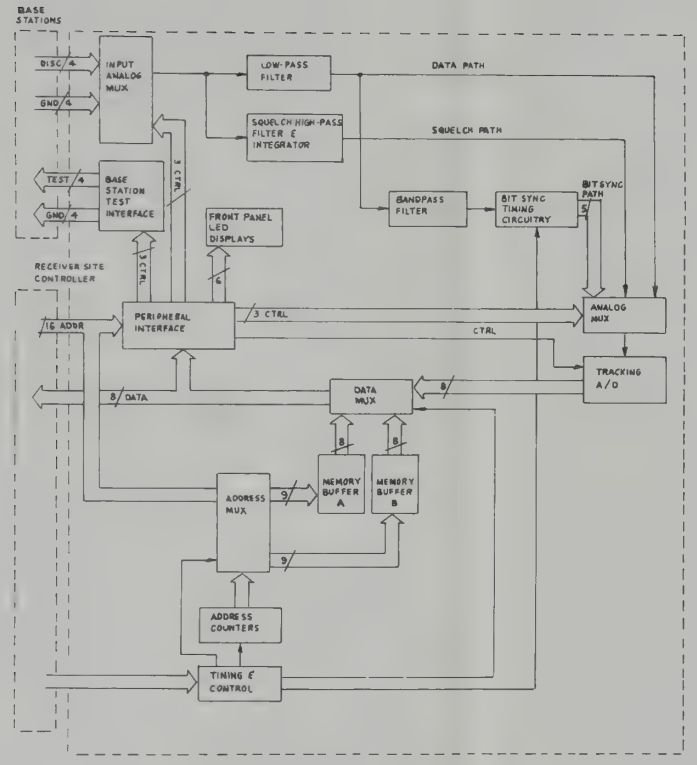
- DS1, red, FAILURE indicator

2.13.2 The PB1 and PB2 signals from pins 11 and 12, respectively, on PIA U37 are decoded into 1-of-4 signals that drive DS4 through DS7. PA4 from U37-6 controls the enable signal on pin 15 of U45, the decoder for the channel indicators. DS3, the DECODE indicator, is controlled by PA7 from U37-9, PA6 from U37-8 controls the UNSQUELCH indicator, DS2. The red FAILURE indicator is controlled by PA5 (U37-7).

2.13.3 During normal operation, all indicators are under software control. A lamp test signal, LPTST, is provided on pin 16 of the edge connector. When low, this signal causes all the LEDs to turn on.

TRN8662B INBOUND RECOVERY BOARD

BLOCK DIAGRAM, CIRCUIT BOARD DETAIL, LOGIC DIAGRAM, AND PARTS LIST


BASE STATIONS
DISC 4
GND 4
INPUT ANALOG MUX
LOW-PASS FILTER
DATA PATH
SQUELCH HIGH-PASS FILTER & INTEGRATOR
SQUELCH PATH
TEST 4
GND 4
BASE STATION TEST INTERFACE
3 CTRL
FRONT PANEL LED DISPLAYS
BANDPASS FILTER
BIT SYNC TIMING CIRCUITRY
BIT SYNC PATH
5
RECEIVER SITE CONTROLLER
3 CTRL
6
16 ADDR
PERIPHERAL INTERFACE
3 CTRL
CTRL
ANALOG MUX
TRACKING A/D
8 DATA
DATA MUX
8
8
8
ADDRESS MUX
9
9
MEMORY BUFFER A
MEMORY BUFFER B
ADDRESS COUNTERS
TIMING & CONTROL

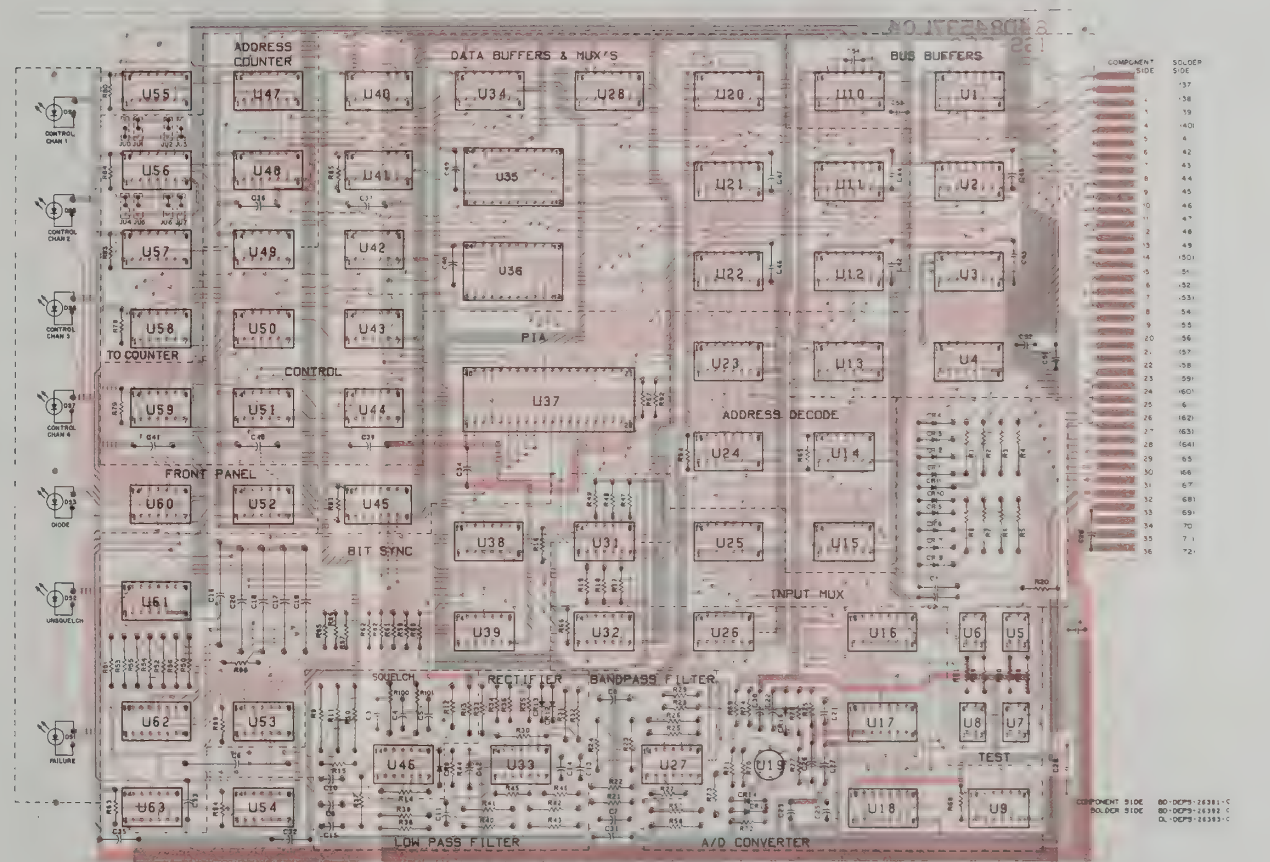
CEPS-26389-O

parts list

TRN8662B Inbound Recovery Board PL-6348-E

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitors; fixed: pF unless otherwise stated
C1, 2	21-84448K03	0.1 uF +80-20%; 50 V
C3, 4, 5	21-82537B49	3900 ±1%; 100 V
C6	8-84326A23	.0213 uF ±2%; 50 V
C7, 8	21-82537B49	3900 ±1%; 100 V
C9	21-82537B38	1000 ±3%; 100 V
C10	21-83107B11	39 ±2%, 500 V
C11	21-84426B54	280 ±5%; 500 V
C12	21-82537B52	250 ±1%; 100 V
C13	21-84494B16	330 ±5%, 500 V
C14	21-848978	190 ±3%; 500 V
C15	21-868823	345 ±3%, 500 V
C16 thru 20	8-84326A23	.0213 uF ±2%; 50 V
C21	21-84493B21	30 ±5%; 200 V
C22	21-84448K03	0.1 uF +80-20%; 50 V
C23, 24, 25	23-11019A46	100 ±20%; 25 V
C26 thru 49	21-84448K03	0.1 uF +80-20%; 50 V
C51	21-82877B33	90 ±10%
C52, 53, 54	21-82877B36	250 ±10%
		diode: (see note)
CR1 thru 8	48-83654H01	silicon
CR9	48-84616A01	silicon, hot carrier
CR10	48-83654H01	silicon
CR11	48-83461E03	Zener, 3.3 V
CR12, 13	48-84616A01	silicon, hot carrier
CR14, 15	48-83654H01	silicon
CR16	48-83461E40	Zener, 5.1 V
		light emitting diode (see note)
DS1	48-88245C17	red
DS2 thru 7	48-88245C18	green
		resistors, fixed: ±5%; 1/4 W: unless otherwise stated
R1 thru 8	6-84640C72	100k ±5%; 1/8 W
R9, 10	6-84640C61	499k ±5%
R11	6-84640C27	2.87k ±5%
R12	6-10621B61	453 ±1%; 1/8 W
R13	6-84444A69	115k ±1%
R14	6-84444A35	49.9k ±1%
R15	6-11009A97	100k
R16	6-11009A49	1k
R17, 18, 19	6-11009A65	4.7k
R20	6-11009A53	1.5k
R21	6-10621D55	45.3k ±1%, 1/8W
R22	6-10621E52	453k ±1%; 1/8 W
R23, 24	6-84640C65	22.6k ±.5%; 1/8 W
R25, 26	6-84640C63	10.7k ±.5%; 1/8 W
R27	6-11009A87	39k
R28	6-11009A81	22k
R29	6-11009A66	5.1k
R30, 31, 32	6-84640C72	100k ±.5%; 1/8 W
R33	6-84444A35	49.9k ±1%
R34	6-11009B08	270k
R35	6-11009A90	51k
R36	6-11009A83	27k
R37 thru 43	6-84640C75	158k ±.5%; 1/8 W
R44	6-11009B14	470k
R45, 46	6-11009B10	330k
R47, 48, 49	6-11009A65	4.7k
R50, 51	6-84640C63	10.7k ±.5%, 1/8 W
R52 thru 56	6-84640C75	158k ±.5%, 1/8 W
R57, 58	6-84640C63	10.7k ±.5%, 1/8 W
R59 thru 62	6-11009A65	4.7k
R63, 64, 65	6-11009A49	1k
R66	6-11009A60	3k
R67, 68	6-11009A49	1k
R69	6-11009A27	120
R70	6-11009A47	820
R71	6-11009B10	330k
R72	6-11009A65	4.7k
R73	6-10621C59	4.64k ±1%; 1/8 W
R74	6-11009A49	1k
R75	6-11009A53	1.5k
R76	6-84444A20	2.55k ±1%; 1/8 W
R77	6-11009A38	360
R78 thru 81	6-11009A49	1k
R82	6-11009A65	4.7k
R83 thru 85	6-11009A49	1k
R88 thru 91	6-11009A33	220
R92	6-11009A97	100k
R94 thru 99	6-11009A32	200
R100, 101	6-10621E47	402k ±1%; 1/8 W
		integrated circuit: (see note)
U1	51-82609M38	hex bus receiver
U2, 3	51-84371K77	quad bus transceiver/MPU bus extender
U4	51-82609M38	hex bus receiver
U5 thru 8	51-84371K82	opto-coupler
U9	51-84561L34	dual D flip-flop
U10	51-82609M38	hex bus receiver
U11,12	51-84371K77	quad bus transceiver/MPU bus extender
U13	51-82609M38	hex bus receiver
U14	51-84561L45	dual 4-input AND gate
U15	51-84561L04	quad 2-input NAND gate
U16	51-84561L50	4-bit binary up/down sync counter
U17	51-82609M09	D/A converter
U18	51-84561L50	4-bit binary up/down sync counter
U19	51-82609M08	comparator
U20	51-84561L48	quadruple 2-input multiplexer
U21, 22	51-84371K77	quad bus 3-state drvr/rcvr
U23	51-84561L41	3-to-8 line decoder/demultiplexer
U24	51-84561L47	dual 1 of 4 decoder/demult o/c output
U25	51-82884L54	analog MUX/DEMUX
U26	51-84561L03	hex inverter
U27	51-84561L75	quad operational amplifier
U28	51-84561L48	quadruple 2-input multiplexer
U31	51-84371K07	hex inverter (o/c)
U32	51-84371K08	hex buffer/driver
U33	51-84561L75	quad operational amplifier
U34	51-84561L48	quadruple 2-input multiplexer
U35, 36	51-83625M70	2k × 8 RAM
U37	51-84561L32	PIA
U38	51-84561L49	synchronous binary 4-bit counter
U39	51-84371K07	hex inverter (o/c)
U40, 41	51-84561L48	quadruple 2-input multiplexer
U42	51-84561L04	quad 2-input NAND gate
U43, 44	51-84561L34	dual D flip-flop
U45	51-84561L42	2-4 line decoder/multiplexer
U46	51-82760P18	quad operational amplifier
U47, 48	51-84561L35	4-bit up/down binary counter
U49	51-84561L34	dual D flip-flop
U50	51-84561L03	hex inverter
U51	51-84561L34	dual D flip-flop
U52	51-84561L46	quad 2-in NOR buffer o/c output
U53, 54	51-82884L14	quad bilateral switch
U55	51-84561L49	synchronous binary 4-bit counter
U56, 57	51-84561L35	4-bit up/down binary counter
U58, 59	51-84561L34	dual D flip-flop
U60	51-84561L46	quad 2-in NOR buffer o/c output
U61, 62	51-82884L46	analog MUX/DEMUX
U63	51-84561L34	dual D flip-flop
		mechanical parts
	3-136890	SCREW, machine: 4-40 × 9/32", 3 used
	9-83469K05	SOCKET
	22-84986F01	PIN, latch
	55-82239K01	LATCH
	41-84891F01	SPRING, latch
	42-84837F01	BEZEL, window frame
	61-84989F01	WINDOW, ID
	64-84680F07	PANEL, front
	28-84729L02	3-PIN JUMPER PLUG, 8 used
	9-84181L01	2-HOLE JUMPER SOCKET

note: For optimum performance, diodes, transistors, and integrated circuits must be ordered by Motorola part numbers.


ADDRESS COUNTER
DATA BUFFERS & MUX'S
BUS BUFFERS
U55
U47
U40
U34
U28
U20
U10
U1
U56
U48
U41
U35
U21
U11
U2
U57
U49
U42
U36
U22
U12
U3
U58
U50
U43
PIA
U23
U13
U4
TO COUNTER
CONTROL
U59
U51
U44
U37
ADDRESS DECODE
U24
U14
FRONT PANEL
U60
U52
U45
BIT SYNC
U38
U31
U25
U15
INPUT MUX
U61
U39
U32
U26
U16
U6
U5
SQUELCH
RECTIFIER
BANDPASS FILTER
U62
U53
U46
U33
U27
U19
U17
U8
U7
TEST
U63
U54
U18
U9
LOW PASS FILTER
A/D CONVERTER
COMPONENT SIDE
SOLDER SIDE

SHOWN FROM COMPONENT SIDE

NOTES:

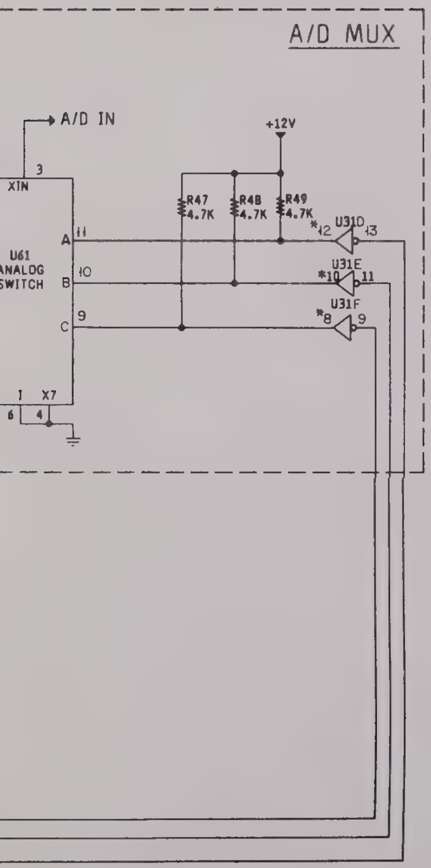
1. Unless otherwise indicated: resistor values are in ohms capacitor values are in microfarads.

2. This diagram shows positive logic:
   TTL & low power schottky logic
   '1' -2.0-5.0 V dc
   '0' -0.0-0.8 V dc
   CMOS logic:
   '1' -8.4-12.0 V dc
   '0' -0.0-3.6 V dc

3. Integrated circuits on this board are low power schottky, TTL, and CMOS devices.

4. IC types and connections for this board are as follows:

Reference Designation	Type	-12	+12	+5	Gnd	Mfgr's Description
U1, 4, 10, 13	MC3437			16	8	Hex. Inv. Rcvr
U2, 3, 11, 12, 21, 22	8T26			16	8	Quad Inv. Xcvr
U5, 6, 7, 8	4N33					Opto Isolator
U9, 43, 44, 49, 51, 58, 59, 63	74LS74			14	7	Dual D FF
U14	74LS21			14	7	Dual 4-Input AND
U15	74LS00			14	7	Dual 2-Input NAND
U16, 18	74LS169			16	8	Binary Synch 4-Bit U/D Cntr
U17	MC1508-L	3		13	2	8-Bit D/A Conv.
U19	LM111H	4	8		1	O.C. Comparator
U20, 28, 34, 40, 41	74LS157			16	8	Quad 2-Input MUX
U23	74LS138			16	8	1 of 8 Line Decoder
U24	74LS156			16	8	Dual 1 of 4 O.C. Dec.
U25	MC14052B		16		8	Dual 4-IN Anl Mux
U26, 50	74LS04			14	7	Hex Inv.
U27, 33	MC3403P	11	4			Quad Op Amp
U35, 36	TC5517AP			24	12	2k × 8 Static RAM
U31, 39	7406			14	7	Hex O.C. Inv.
U32	7407			14	7	Hex. O.C. Buff.
U37	MC6821			20	1	PIA
U38, 55	74LS161			16	8	Synch Binary 4-Bit Cntr.
U42	74LS00			14	7	Quad 2-Input NAND
U45	74LS139			16	8	Dual 1 of 4 Dec.
U46	TL084	11	4			Quad Op Amp
U47, 48, 56, 57,	74LS193			16	8	Binary Synch U.D. Cntr.
U52, 60	74LS33			14	7	Quad 2-IN NOR O.C.
U53, 54	MC14016B		14		7	Quad Anl SW
U61, 62	MC14051B		16		7, 8	8-Input Anl SW



5. C28 thru C50 are bypass capacitors connected to the +5 V bus. Refer to circuit board detail for location.

6. The following are the unused gates of the integrated circuits:

   U32B pin 3 is pulled up to +5 V thru a 1k resistor

   U26B pin 3 is pulled up to +5 V thru a 1k resistor

   U39E pin 11 is pulled up to +5 V thru a 1k resistor

   U15D pins 12 & 13 are pulled to +5 V thru a 1k resistor

   U54D pins 10, 11, & 12 are tied to Gnd

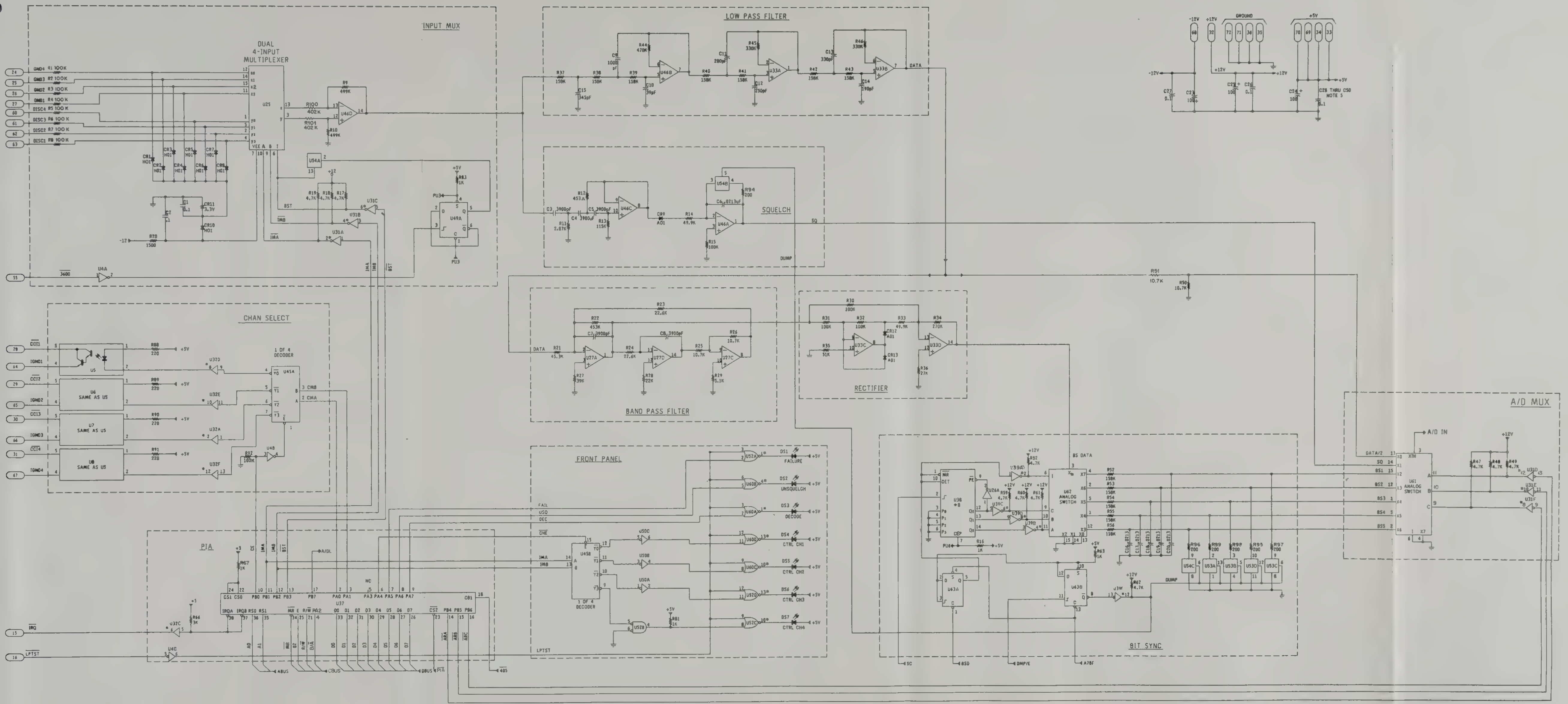
7. All gate outputs marked with a * are open collector devices.

EEPS-26390-G
SHEET 1 OF 3

INBOUND RECOVERY BOARD
BLOCK DIAGRAM, CIRCUIT BOARD DETAIL, LOGIC DIAGRAM, AND PARTS LIST

TRN8662B INBOUND RECOVERY BOARD

BLOCK DIAGRAM, CIRCUIT BOARD DETAIL,
LOGIC DIAGRAM, AND PARTS LIST


INPUT MUX
DUAL 4-INPUT MULTIPLEXER
LOW PASS FILTER
SQUELCH
CHAN SELECT
BAND PASS FILTER
RECTIFIER
FRONT PANEL
PIA
BIT SYNC
A/D MUX
GROUND
FAILURE
UNSQUELCH
DECODE
CTRL CH1
CTRL CH2
CTRL CH3
CTRL CH4
DATA
SQ
DUMP
ANALOG SWITCH
1 OF 8 DECODER
1 OF 4 DECODER
SAME AS U5

NOTES

1. Unless otherwise indicated: resistor values are in ohms capacitor values are in microfarads

2. This diagram shows positive logic
   TTL & low power schottky logic
   '1' -2.0-5.0 V dc
   '0' -0.0-0.8 V dc
   CMOS logic:
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U2, 3, 11, 12, 21, 22	8T26			16	8	Quad Inv Xcvr
U5, 6, 7, 8	4N33					Opto Isolator
U9, 43, 44, 49, 51, 58, 59, 63	74LS74			14	7	Dual D FF
U14	74LS21			14	7	Dual 4-Input AND
U15	74LS00			14	7	Dual 2-Input NAND
U16, 18	74LS169			16	8	Binary Synch 4-Bit U/D Cntr
U17	MC1508-L	3		13	2	8-Bit D/A Conv
U19	LM111H	4	8		1	O C Comparator
U20, 28, 34, 40, 41	74LS157			16	8	Quad 2-Input MUX
U23	74LS138			16	8	1 of 8 Line Decoder
U24	74LS156			16	8	Dual 1 of 4 O.C Dec
U25	MC14052B		16		8	Dual 4-IN Anl Mux
U26, 50	74LS04			14	7	Hex Inv
U27, 33	MC3403P	11	4			Quad Op Amp
U35, 36	TC5517AP			24	12	2k × 8 Static RAM
U31, 39	7406			14	7	Hex O.C Inv
U32	7407			14	7	Hex. O.C. Buff
U37	MC6821			20	1	PIA
U38, 55	74LS161			16	8	Synch Binary 4-Bit Cntr
U42	74LS00			14	7	Quad 2-Input NAND
U45	74LS139			16	8	Dual 1 of 4 Dec
U46	TL084	11	4			Quad Op Amp
U47, 48, 56, 57,	74LS193			16	8	Binary Synch U.D. Cntr
U52, 60	74LS33			14	7	Quad 2-IN NOR O.C
U53, 54	MC14016B		14		7	Quad Anl SW
U61, 62	MC14051B		16		7, 8	8-Input Anl SW

5. C28 thru C50 are bypass capacitors connected to the +5 V bus. Refer to circuit board detail for location

6. The following are the unused gates of the integrated circuits

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   U39E pin 11 is pulled up to +5 V thru a 1k resistor

   U15D pins 12 & 13 are pulled to +5 V thru a 1k resistor

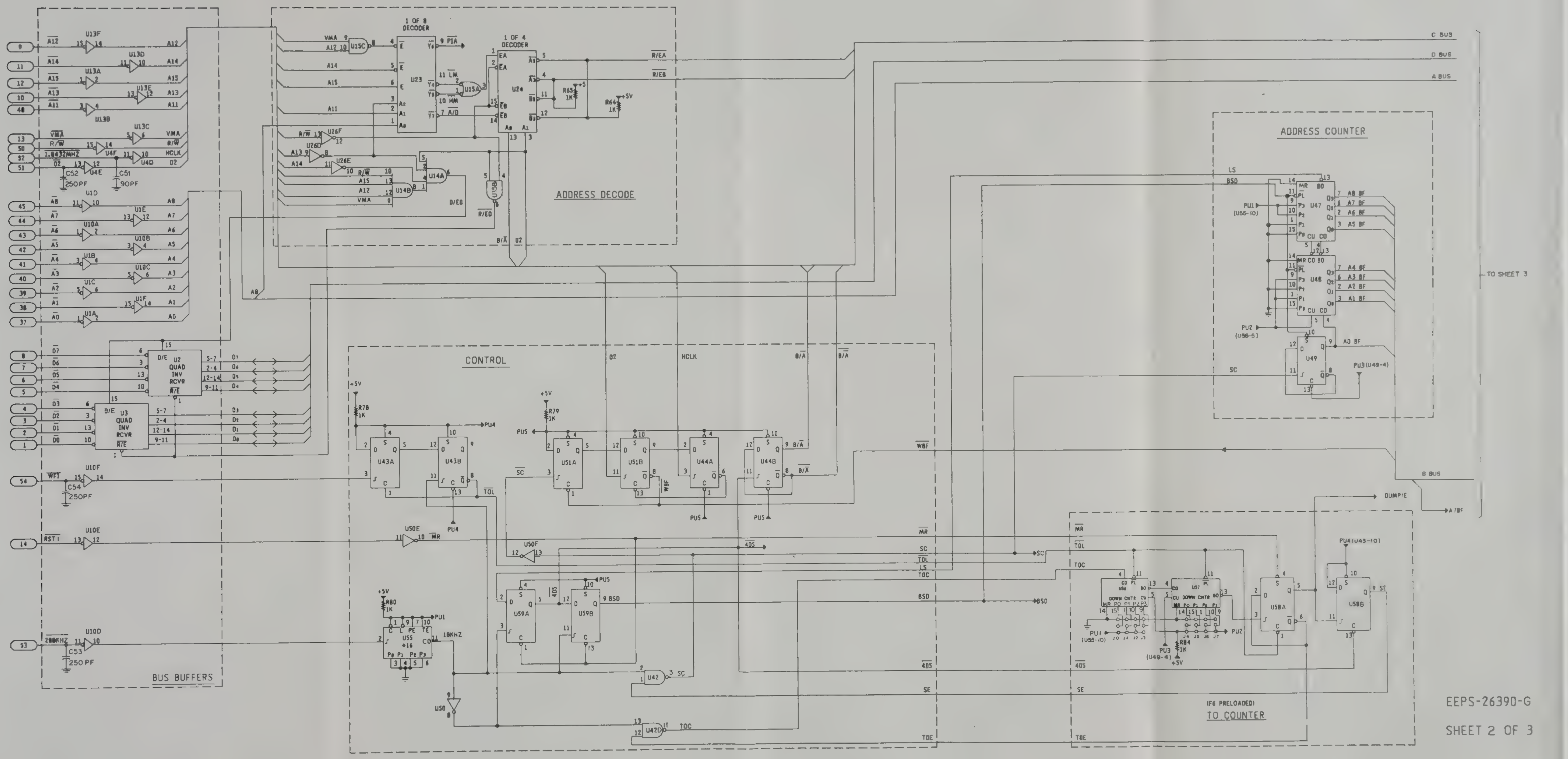
   U54D pins 10, 11, & 12 are tied to Gnd

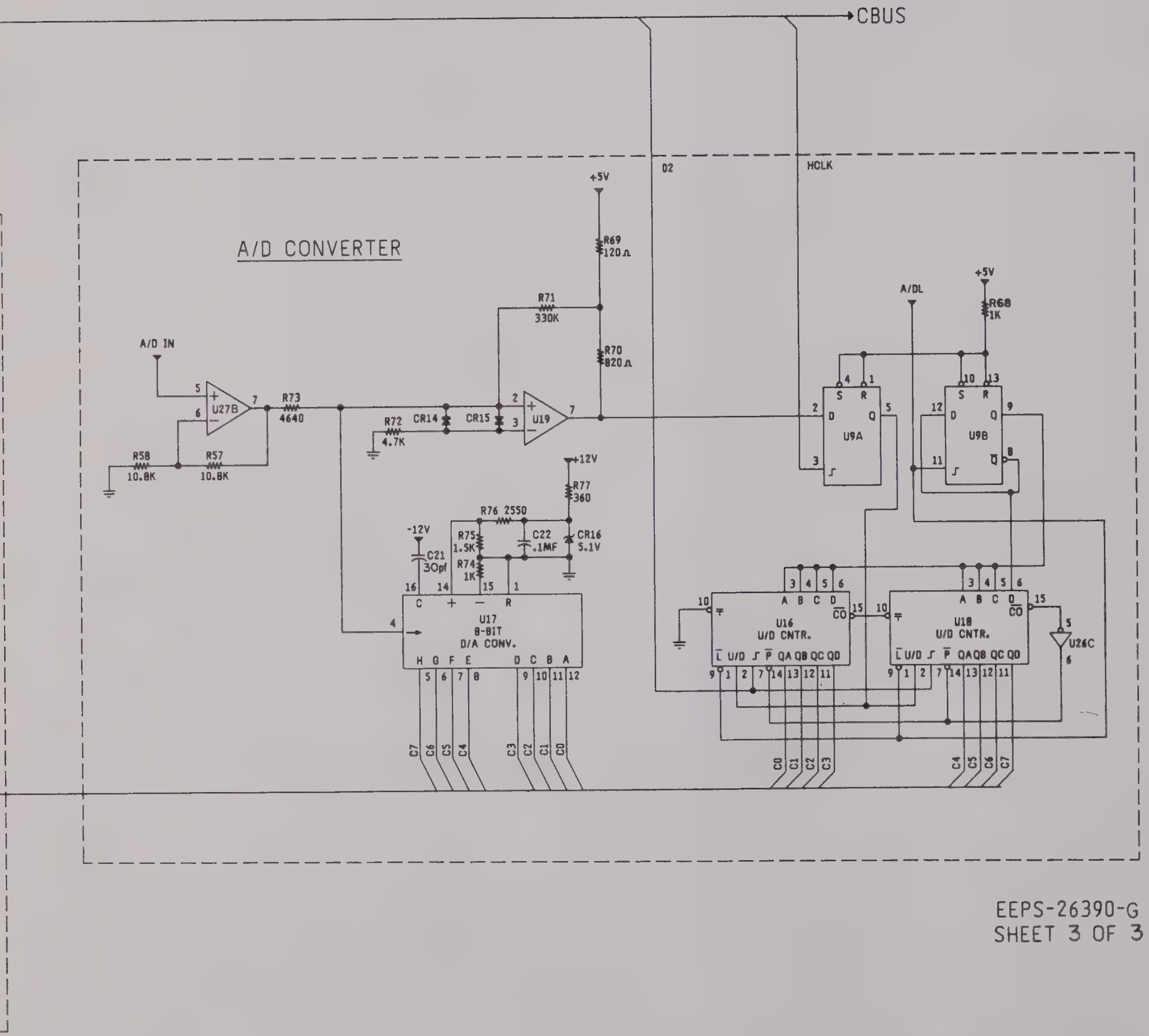
7. All gate outputs marked with a * are open collector devices

EEPS-26390-G
SHEET 1 OF 3

TRN8662B INBOUND RECOVERY BOARD

BLOCK DIAGRAM, CIRCUIT BOARD DETAIL,
LOGIC DIAGRAM, AND PARTS LIST


BUS BUFFERS
1 OF 8 DECODER
1 OF 4 DECODER
ADDRESS DECODE
CONTROL
ADDRESS COUNTER
C BUS
D BUS
A BUS
B BUS
TO SHEET 3
DUMP/E
A/BF
(F6 PRELOADED)
TO COUNTER
EEPS-26390-G
SHEET 2 OF 3


CBUS
D2
HCLK
A/D CONVERTER
A/D IN
U27B
R73 4640
R58 10.8K
R57 10.8K
R72 4.7K
CR14
CR15
U19
+5V
R69 120Ω
R71 330K
R70 820Ω
A/DL
R68 1K
U9A
U9B
+12V
R77 360
R76 2550
-12V
C21 30pf
R75 1.5K
R74 1K
C22 .1MF
CR16 5.1V
U17 8-BIT D/A CONV.
U16 U/D CNTR.
U18 U/D CNTR.
U26C
C7 C6 C5 C4 C3 C2 C1 C0
C0 C1 C2 C3
C4 C5 C6 C7

EEPS-26390-G
SHEET 3 OF 3

MOTOROLA INC.
Communications
Sector

RECEIVER INTERFACE BOARD MODULE

MODEL TRN8661A

1. INTRODUCTION

The TRN8661A Receiver Interface Board (RIB) Module provides the interface between the Motorola Trunked Radio System base repeater receiver and the M6800 Microprocessor used in the receiver site controller (RSC). Since each RIB interfaces with up to seven receivers, three RIB modules are required for a system employing twenty channels. Each RIB is used to:

- detect the inbound 1800 Hz acknowledge tone from mobile units requesting a voice channel,
- detect the inbound 105.8 Hz connect tone from mobile units transmitting on a voice channel,
- detect the inbound 163.6 Hz disconnect tone from mobile units leaving the assigned voice channels,
- receive the rf carrier status from the repeater, indicating that the repeater receiver is quieted,
- interface to the M6800 Microprocessor via two M6821 Peripheral Interface Adaptors (PIAs).

2. FUNCTIONAL DESCRIPTION

2.1 Bidirectional receivers/transmitters U1 and U2 buffer the data lines from the RSC to the RIB, and receivers U3 and U4 buffer the data lines. Since the RIB needs only to partially decode the required address, only A0, A1, A2, A3, A5, A6, A7, A8, and ADEC are required. ADEC, provided by the RSC, is a combination of A13, A14, A15, 02, and VMA. A5, A6, and A7 are tied together on the RIB since the backplane connects A5 to RIB1, A6 to RIB2, and A7 to RIB3; thus the following addresses are decoded by the RIBs:

- $8020 to $8027 for RIB1
- $8040 to $8047 for RIB2
- $8080 to $8087 for RIB3

2.2 The circuit descriptions outlined in the following paragraphs relate to channel 1. Channels 2 through 7 are identical except for the designation of components. The DISC1 (discriminator) signal from the repeater receiver is buffered by the Trunk Control Module (TCM) and received differentially by U8A on the RIB. (For further information, see the Trunk Control Module section in the base repeater instruction manual.) C1 and C2 isolate any dc bias from U8A to the rest of the circuit. At this point, the DISC signal is divided into two paths — one feeding the high-speed and disconnect tone detectors and the other feeding the low-speed tone detector. CR1 and CR2 clip the signal to approximately 1 volt peak-to-peak. C3 and C7 block the dc bias of the tone detectors from the diode circuitry. The other path is identical except for the addition of C5 and C6 which, together with R16, form a low-pass filter. This filter attenuates the voice frequencies that could mask the low-speed connect tone during a call.

2.3 Tone detectors U35, U42, and U49 are digital integrated circuits that operate on the phase-locked loop principle. C12, C13, and R19 determine the free-running frequency of tone detector U35; this frequency is three times the tone frequency. R17, R18, C8, C9, C10, and C11 determine the actual detect time and noise immunity of the circuit. C14 centers the tone detector bandwidth around the desired center frequency.

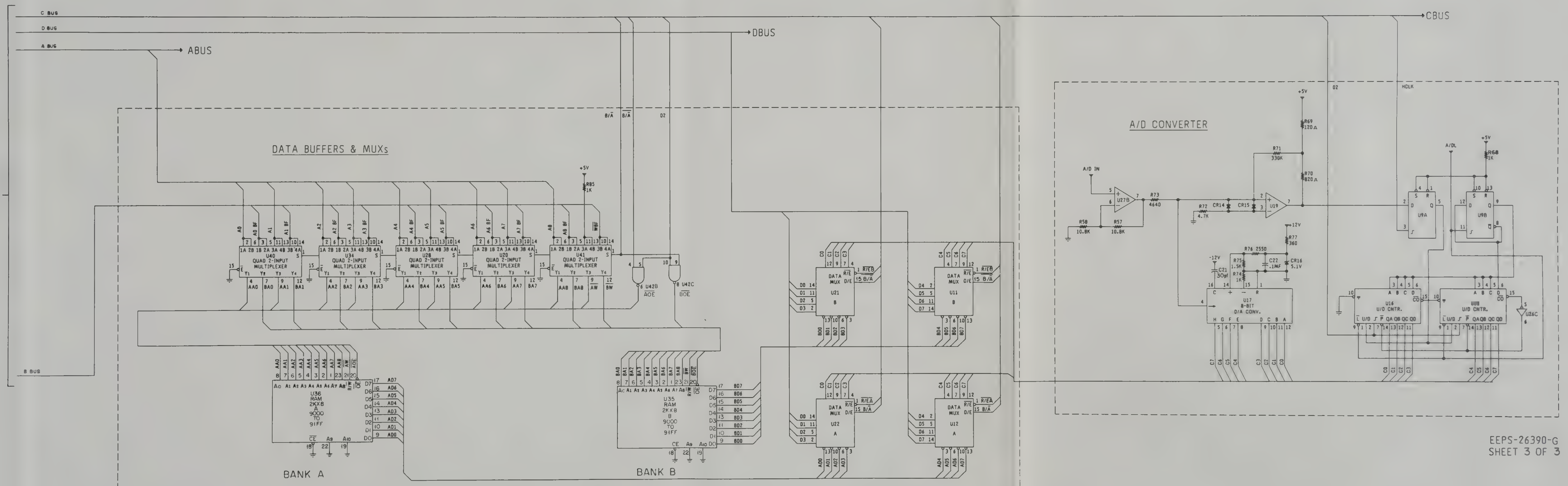
2.4 The outputs of two channels of the tone detectors are fed to U19, an 8-input multiplexer. Software control of the multiplexer is provided by peripheral interface adaptor U10, pin 19. The software program determines which channels should be scanned for tones. Since the four multiplexers on the RIB are controlled by this single line, one half of the channels can be read at one time. Inversion of the control signal permits the reading of the other half of the channels. Thus, when U10-19 is high, channels 1, 2, 3, and 4 are read; when U10-19 is low, channels 5, 6, and 7 are read.

2.5 The base repeater provides an RSTAT1 signal that indicates that the receiver is quieted by an rf carrier. Opto-isolator U12 receives the RSTAT1 signal and its return, RGND1. The signal is then fed to the multiplexers with the tone information and then to the PIA. When an rf carrier is present on the channel, the corresponding green indicator on the front panel turns on.

technical writing services
1301 E. Algonquin Road, Schaumburg, IL 60196

TRN8662B INBOUND RECOVERY BOARD

BLOCK DIAGRAM, CIRCUIT BOARD DETAIL,
LOGIC DIAGRAM, AND PARTS LIST


C BUS
D BUS
A BUS
B BUS
FROM SHEET 2
ABUS
DBUS
CBUS
DATA BUFFERS & MUXs
B/Ā
B/Ā
D2
+5V
R85 1K
A0
A0 BF
A1
A1 BF
A2
A2 BF
A3
A3 BF
A4
A4 BF
A5
A5 BF
A6
A6 BF
A7
A7 BF
A8
A8 BF
W̄B̄F̄
U40 QUAD 2-INPUT MULTIPLEXER
U34 QUAD 2-INPUT MULTIPLEXER
U28 QUAD 2-INPUT MULTIPLEXER
U20 QUAD 2-INPUT MULTIPLEXER
U41 QUAD 2-INPUT MULTIPLEXER
AA0
BA0
AA1
BA1
AA2
BA2
AA3
BA3
AA4
BA4
AA5
BA5
AA6
BA6
AA7
BA7
AA8
BA8
ĀW̄
BW
U42B
ĀŌĒ
U42C
B̄ŌĒ
U36 RAM 2KX8 A 9000 TO 91FF
U35 RAM 2KX8 B 9000 TO 91FF
AD0
AD1
AD2
AD3
AD4
AD5
AD6
AD7
BD0
BD1
BD2
BD3
BD4
BD5
BD6
BD7
BANK A
BANK B
DATA MUX U21 B
DATA MUX U11 B
DATA MUX U22 A
DATA MUX U12 A
R̄/ĒB
R̄/ĒA
B/Ā
A/D CONVERTER
A/D IN
U27B
R73 4640
R58 10.8K
R57 10.8K
R72 4.7K
CR14
CR15
U19
+5V
R69 120Ω
R71 330K
R70 820Ω
+12V
R77 360
R76 2550
R75 1.5K
R74 1K
C22 .1MF
CR16 5.1V
-12V
C21 30pf
U17 8-BIT D/A CONV.
C0
C1
C2
C3
C4
C5
C6
C7
D2
HCLK
A/DL
R68 1K
U9A
U9B
U16 U/D CNTR.
U/D CNTR.
U26C
EEPS-26390-G
SHEET 3 OF 3

MOTOROLA INC.
Communications
Sector

RECEIVER INTERFACE BOARD MODULE
MODEL TRN8661A

1. INTRODUCTION

The TRN8661A Receiver Interface Board (RIB) Module provides the interface between the Motorola Trunked Radio System base repeater receiver and the M6800 Microprocessor used in the receiver site controller (RSC). Since each RIB interfaces with up to seven receivers, three RIB modules are required for a system employing twenty channels. Each RIB is used to:

- detect the inbound 1800 Hz acknowledge tone from mobile units requesting a voice channel,
- detect the inbound 105.8 Hz connect tone from mobile units transmitting on a voice channel,
- detect the inbound 163.6 Hz disconnect tone from mobile units leaving the assigned voice channels,
- receive the rf carrier status from the repeater, indicating that the repeater receiver is quieted,
- interface to the M6800 Microprocessor via two M6821 Peripheral Interface Adaptors (PIAs).

2. FUNCTIONAL DESCRIPTION

2.1 Bidirectional receivers/transmitters U1 and U2 buffer the data lines from the RSC to the RIB, and receivers U3 and U4 buffer the data lines. Since the RIB needs only to partially decode the required address, only A0, A1, A2, A3, A5, A6, A7, A8, and ADEC are required. ADEC, provided by the RSC, is a combination of A13, A14, A15, 02, and VMA. A5, A6, and A7 are tied together on the RIB since the backplane connects A5 to RIB1, A6 to RIB2, and A7 to RIB3; thus the following addresses are decoded by the RIBs:

- $8020 to $8027 for RIB1
- $8040 to $8047 for RIB2
- $8080 to $8087 for RIB3

2.2 The circuit descriptions outlined in the following paragraphs relate to channel 1. Channels 2 through 7 are identical except for the designation of components. The DISC1 (discriminator) signal from the repeater receiver is buffered by the Trunk Control Module (TCM) and received differentially by U8A on the RIB. (For further information, see the Trunk Control Module section in the base repeater instruction manual.) C1 and C2 isolate any dc bias from U8A to the rest of the circuit. At this point, the DISC signal is divided into two paths — one feeding the high-speed and disconnect tone detectors and the other feeding the low-speed tone detector. CR1 and CR2 clip the signal to approximately 1 volt peak-to-peak. C3 and C7 block the dc bias of the tone detectors from the diode circuitry. The other path is identical except for the addition of C5 and C6 which, together with R16, form a low-pass filter. This filter attenuates the voice frequencies that could mask the low-speed connect tone during a call.

2.3 Tone detectors U35, U42, and U49 are digital integrated circuits that operate on the phase-locked loop principle. C12, C13, and R19 determine the free-running frequency of tone detector U35; this frequency is three times the tone frequency. R17, R18, C8, C9, C10, and C11 determine the actual detect time and noise immunity of the circuit. C14 centers the tone detector bandwidth around the desired center frequency.

2.4 The outputs of two channels of the tone detectors are fed to U19, an 8-input multiplexer. Software control of the multiplexer is provided by peripheral interface adaptor U10, pin 19. The software program determines which channels should be scanned for tones. Since the four multiplexers on the RIB are controlled by this single line, one half of the channels can be read at one time. Inversion of the control signal permits the reading of the other half of the channels. Thus, when U10-19 is high, channels 1, 2, 3, and 4 are read; when U10-19 is low, channels 5, 6, and 7 are read.

2.5 The base repeater provides an $\overline{\mathrm{RSTAT1}}$ signal that indicates that the receiver is quieted by an rf carrier. Opto-isolator U12 receives the $\overline{\mathrm{RSTAT1}}$ signal and its return, RGND1. The signal is then fed to the multiplexers with the tone information and then to the PIA. When an rf carrier is present on the channel, the corresponding green indicator on the front panel turns on.

2.6 The RIB front panel is provided with seven switches, SW1 through SW7. When a switch is depressed or released, a corresponding signal flows into PIA U9; this signal is read by the RSC software which, in turn, causes the corresponding channel to be enabled or disabled. When a channel is disabled, the corresponding yellow indicator on the front panel is turned on by U9.

2.7 The RIB also has provisions for testing the 21 tone detectors. A software diagnostic program in the RSC generates the three desired tone frequencies: 105.8, 163.6, and 1800 Hz. The tone frequencies are forwarded to U9-9 and are fed to decoder U29. Three lines from U9-17, U9-19, and U9-39 are also fed to decoder U29 and are used to gate the tone frequencies to one of the seven channels. The tones coming from the decoder are fed through C4 to the input differential amplifier. From this point, the tone path is the same as if the tones were coming from the receiver discriminator. The software diagnostic program then measures the amount of time required to detect the tones and determines whether or not the tone detectors are working properly.

3. FRONT PANEL

Each RIB front panel is provided with a green LED indicator, a yellow LED indicator and a switch for each channel controlled by the RIB. When lit, the green LED indicates that the receiver has detected an rf carrier (RSTAT1) on the specified channel. The yellow LED, when lit, indicates that the associated channel has been disabled. A channel is disabled by pushing the associated switch to the in position, and is enabled by releasing it into the out position. The switch has no effect, however, unless the key switch on the receiver site controller is set to the SERVICE position.

PL-6287-C

DESCRIPTION

ed: uF
ise stated
V
V
50 V
V
V
/
V
; 100 V
500 V
/
) V
; 100 V
500 V
) V
) V
; 100 V
500 V
25 V
50 V

ote)
rrier

diode: (see note)

d: ±5%; 1/4 W
ise stated

2 W

2 W

hbutton
ush

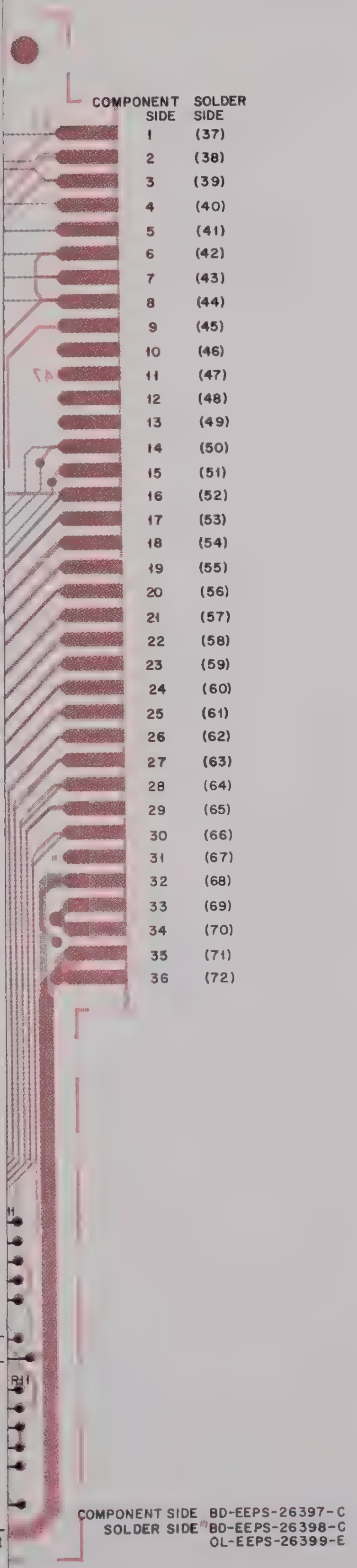
uits: (see note)

; 7 used
tand-off; 14 used
ine; 4-90 x 9/32"; 3 used

and integrated circuits must

TRN8661A RECEIVER INTERFACE BOARD

BLOCK DIAGRAM, CIRCUIT BOARD DETAIL, LOGIC DIAGRAM, AND PARTS LIST


COMPONENT SIDE
SOLDER SIDE
1 (37)
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34 (70)
35 (71)
36 (72)

COMPONENT SIDE BD-EEPS-26397-C
SOLDER SIDE BD-EEPS-26398-C
OL-EEPS-26399-E

2.6 The RIB front panel is provided with seven switches, SW1 through SW7. When a switch is depressed or released, a corresponding signal flows into PIA U9; this signal is read by the RSC software which, in turn, causes the corresponding channel to be enabled or disabled. When a channel is disabled, the corresponding yellow indicator on the front panel is turned on by U9.

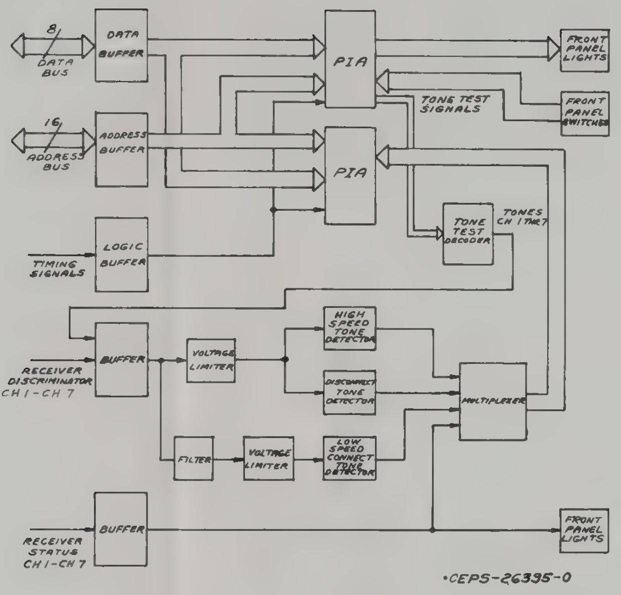
2.7 The RIB also has provisions for testing the 21 tone detectors. A software diagnostic program in the RSC generates the three desired tone frequencies: 105.8, 163.6, and 1800 Hz. The tone frequencies are forwarded to U9-9 and are fed to decoder U29. Three lines from U9-17, U9-19, and U9-39 are also fed to decoder U29 and are used to gate the tone frequencies to one of the seven channels. The tones coming from the decoder are fed through C4 to the input differential amplifier. From this point, the tone path is the same as if the tones were coming from the receiver discriminator. The software diagnostic program then measures the amount of time required to detect the tones and determines whether or not the tone detectors are working properly.

3. FRONT PANEL

Each RIB front panel is provided with a green LED indicator, a yellow LED indicator and a switch for each channel controlled by the RIB. When lit, the green LED indicates that the receiver has detected an rf carrier ($\overline{\text{RSTAT1}}$) on the specified channel. The yellow LED, when lit, indicates that the associated channel has been disabled. A channel is disabled by pushing the associated switch to the in position, and is enabled by releasing it into the out position. The switch has no effect, however, unless the key switch on the receiver site controller is set to the SERVICE position.

TRN8661A RECEIVER INTERFACE BOARD

BLOCK DIAGRAM, CIRCUIT BOARD DETAIL, LOGIC DIAGRAM, AND PARTS LIST

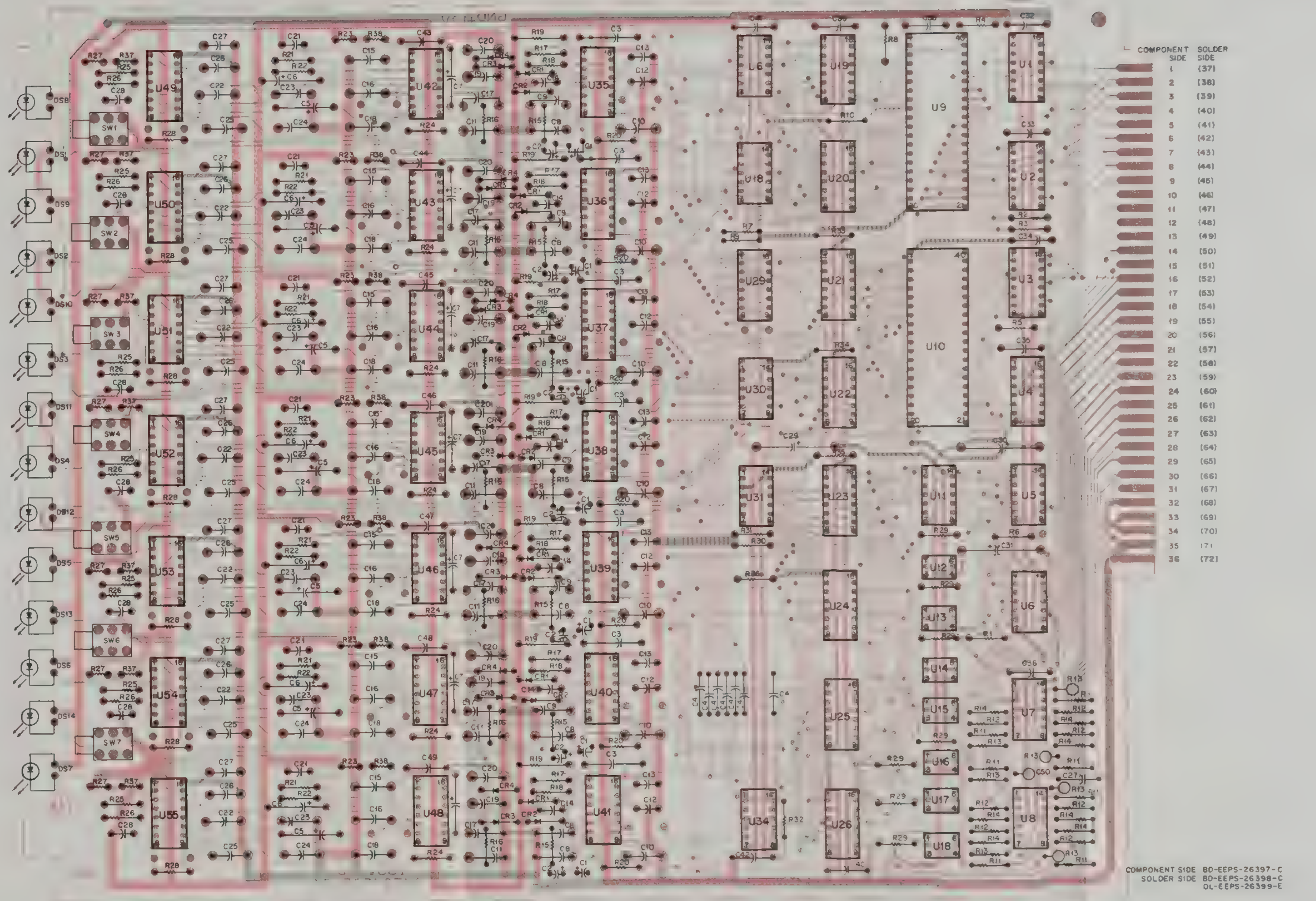

8
DATA BUS
DATA BUFFER
16
ADDRESS BUS
ADDRESS BUFFER
PIA
PIA
FRONT PANEL LIGHTS
FRONT PANEL SWITCHES
TONE TEST SIGNALS
TONE TEST DECODER
TONES CH 1 THR 7
TIMING SIGNALS
LOGIC BUFFER
RECEIVER DISCRIMINATOR CH1-CH7
BUFFER
VOLTAGE LIMITER
HIGH SPEED TONE DETECTOR
DISCONNECT TONE DETECTOR
MULTIPLEXER
FILTER
VOLTAGE LIMITER
LOW SPEED CONNECT TONE DETECTOR
RECEIVER STATUS CH1-CH7
BUFFER
FRONT PANEL LIGHTS
•CEPS-26395-0

parts list

TRN8661A Receiver Interface Board PL-6287-C

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitors, fixed: uF unless otherwise stated
C1, 2	23-82783B27	10 ±10%; 25 V
C3	23-82783B10	1.0 ±20%; 25 V
C4	21-84448K03	0.1 +80-20%; 50 V
C5, 6	23-82783B16	2.2 ±10%; 15 V
C7	23-82783B10	1.0 ±20%; 50 V
C8, 9	8-83813H18	.02 ±5%; 50 V
C10, 11	8-83813H28	.01 ±5%; 100 V
C12, 13	21-82537B55	1200 pF ±1%; 100 V
C14	21-84494B16	330 pF ±5%; 500 V
C15, 16	8-83813H18	.02 ±5%; 50 V
C17, 18	8-83813H34	.033 ±5%; 100 V
C19, 20	21-82537B92	3000 pF ±1%, 100 V
C21	21-84494B16	330 pF ±5%; 500 V
C22, 23	8-82095G16	.056 ±5%, 200 V
C24, 25	8-83813H34	.033 ±5%, 100 V
C26, 27	21-82537B47	1600 pF ±1%, 100 V
C28	21-84494B16	330 pF ±5%; 500 V
C29, 30, 31	23-84669A05	50 +150-10%, 25 V
32 thru 50	21-84448K03	0.1 +80-20%; 50 V
		diodes: (see note)
CR1 thru 4	48-84616A01	silicon, hot-carrier
		light emitting diode: (see note)
DS1 thru 7	48-88245C19	yellow
DS8 thru 14	48-88245C18	green
		resistors, fixed: ±5%; 1/4 W unless otherwise stated
R1 thru 5	6-11009C49	1k
R6 thru 10	6-11009C73	10k
R11 thru 14	6-11009D15	510k
R15	6-11009C49	1k
R16	6-11009C57	2.2k
R17	6-11009D18	680k
R18	6-11009D16	560k
R19	6-84444A75	110k ±1%
R20	6-84444C73	10k
R21	6-84444D18	680k
R22	6-84444D15	510k
R23	6-84444A59	750k ±1%; 1/2 W
R24	6-84444C73	10k
R25	6-84444D18	680k
R26	6-84444D15	510k
R27	6-84444A76	909k ±1%; 1/2 W
R28	6-84444C73	10k
R29	6-84444C49	1k
R30, 31	6-84444C73	10k
R32 thru 36	6-84444C49	1k
R37	6-11009E91	56k
R38	6-11009E89	47k
		switches, pushbutton
SW1 thru 7	40-84324C17	2-pole, push-push
		integrated circuits: (see note)
U1, 2	51-84371K77	type 8T26
U3, 4	51-82609M38	type 8T37
U5	51-84561L03	type 74LS04
U6	51-84371K84	type 74LS20
U7, 8	51-84561L75	type MC3403
U9, 10	51-84561L32	type MC6821
U11	51-84561L46	type 74LS33
U12 thru 18	51-84371K82	type 4N33
U19, 20	51-82884L25	type MC14519
U21 thru 24	51-82884L20	type MC14009
U25, 26	51-82884L25	type MC14519
U27, 28	51-84561L46	type 74LS33
U29	51-82884L46	type 14051
U30	51-84561L46	type 74LS33
U31	51-84371K07	type 7406
U34	51-84371K83	type 74LS03
U35 thru 55	51-82609M10	type FX105
		mechanical parts
	41-84891F01	SPRING, latch
	38-84683F01	BUTTON, push; 7 used
	14-84891E02	INSULATOR, stand-off; 14 used
	3-136890	SCREW, machine; 4-90 x 9/32"; 3 used
	61-84989F01	WINDOW, ID
	64-84680F09	PANEL
	22-84986F01	PIN, latch
	42-84837F01	BEZEL
	55-82239K01	LATCH

note: For optimum performance, diodes, transistors, and integrated circuits must be ordered by Motorola part numbers.


COMPONENT SIDE
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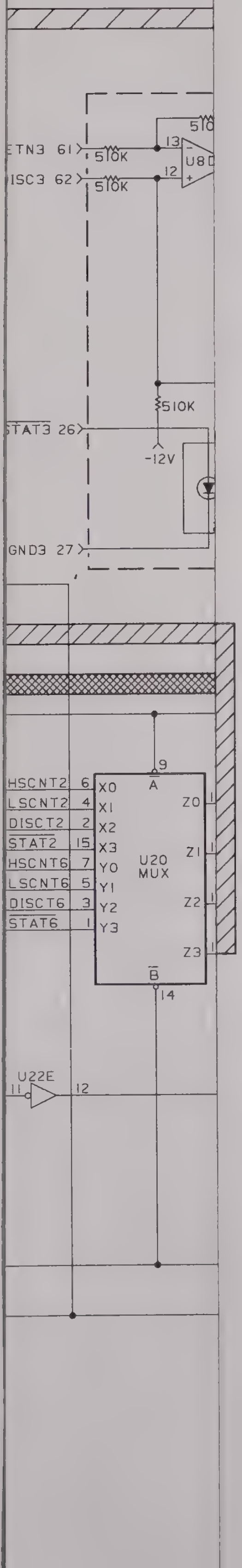
U55

COMPONENT SIDE BD-EEPS-26397-C
SOLDER SIDE BD-EEPS-26398-C
OL-EEPS-26399-E

SHOWN FROM COMPONENT SIDE



ETN3 61
ISC3 62
510K
510K
510
13
12
U8
510K
STAT3 26
-12V
GND3 27
9
A
HSCNT2 6
LSCNT2 4
DISCT2 2
STAT2 15
HSCNT6 7
LSCNT6 5
DISCT6 3
STAT6 1
X0
X1
X2
X3
Y0
Y1
Y2
Y3
U20
MUX
Z0
Z1
Z2
Z3
B
14
U22E
11
12

TRN8661A RECEIVER INTERFACE BOARD

BLOCK DIAGRAM, CIRCUIT BOARD DETAIL, LOGIC DIAGRAM, AND PARTS LIST

NOTES:

1. Unless otherwise indicated: resistor values are in ohms; capacitor values are in microfarads.
2. This diagram shows positive logic:

   TTL, LSTTL — [Logic "1" 2 to 5 V dc
   Logic "0" 0 to .8 V dc

   CMOS ——— [Logic "1" 8.4 to 12 V dc
   Logic "0" 0 to 3.6 V dc.

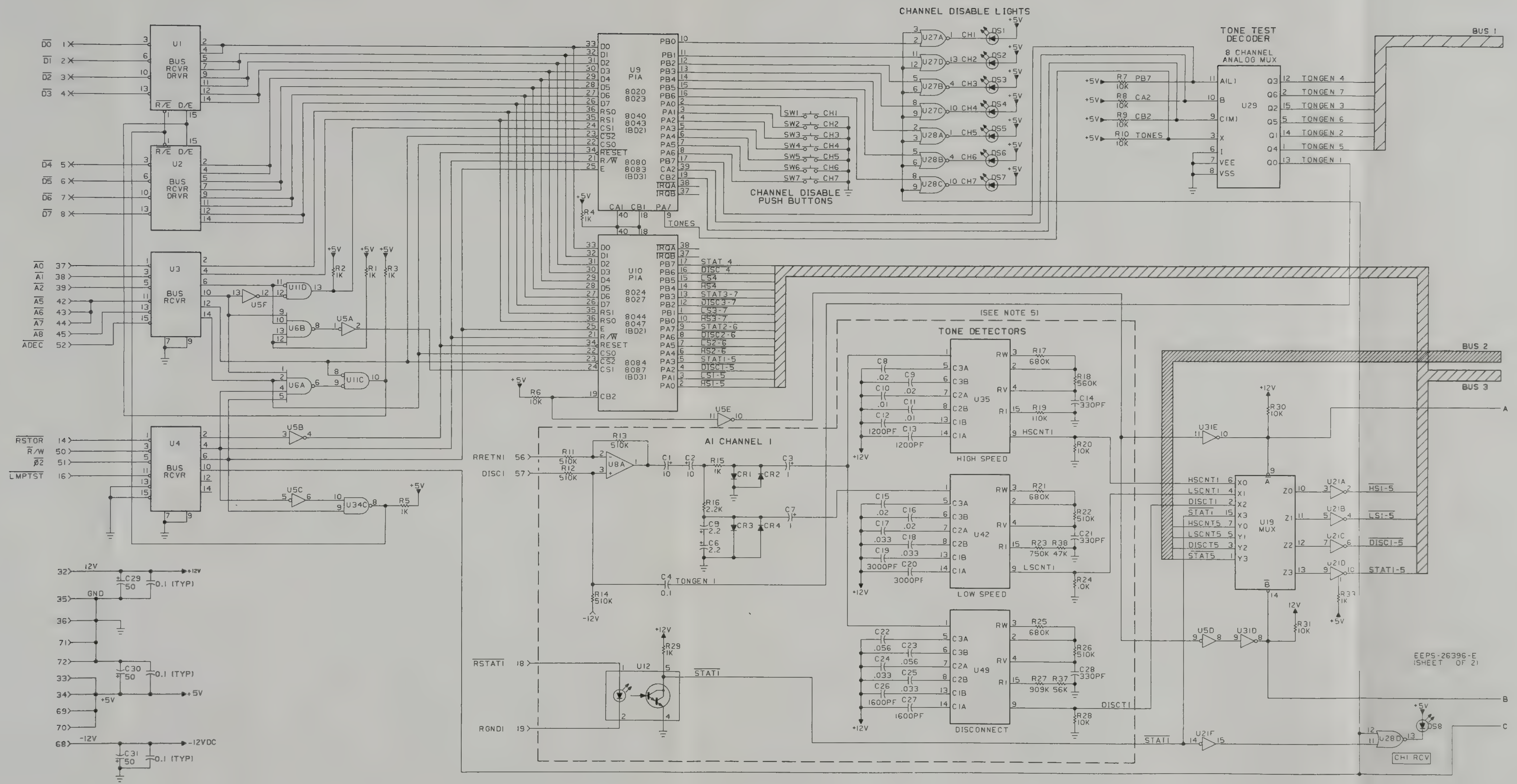
3. Integrated circuits on this board are TTL, LSTTL, and CMOS devices.
4. IC types and connections for this board are as follows:

Reference Designation	Type	VCC +5 V	Gnd	Mfgr's Description
U1, 2	8T26	16	8	Quad Bus Rcvr/Driver
U3, 4	8T37	16	8	Hex Bus Rcvr
U5	74LS04	14	7	Hex Buffer
U6	74LS20	14	7	Dual 4-In NAND
U7, 8	MC3403	4 (+12 V)	11 (-12 V)	Quad Op-Amp
U9, 10	MC6821	20	1	PIA
U11, 27, 28, 30	74LS33	14	7	Quad 2-In NOR (OC)
U12, 13, 14, 15, 16, 17, 18	4N33	—	—	Opto Isolator
U19, 20, 25, 26	MC14519	16	8	4-Bit And/Or Sel
U21, 22, 23, 24	MC14009	16 (+12 V) 1 (+5 V)	8	Hex Inv/Buf
U29	MC14051	16	7, 8	8-Chan ANL Mux
U31	7406	14	7	Hex Buffer
U34	74LS03	14	7	Quad 2-In NAND (OC)
U35 thru 55	FX105	16 (+12 V)	10	Tone Detector

5. Identical circuits are used for A1 channel 1 through A7 channel 7 except for the circuit board connector input pin numbers and the corresponding operational amplifier pins. Refer to the channel 1 parts list for discrete components.
6. The following are the unused gates of the integrated circuits:
   U7A, pins 2 & 3 are tied to gnd.
   U21E, pin 11 is tied to +12 V
   U31A, B, C, F, pins 1, 3, 5, & 13 are pulled up to +5 V thru a 1k resistor.
   U34A, B, D, pins 1, 2, 4, 5, 12, & 13 are pulled up to +5 V thru a 1k resistor.
7. IC's U21, 22, 23, 24 have CMOS logic level inputs and TTL logic level outputs.

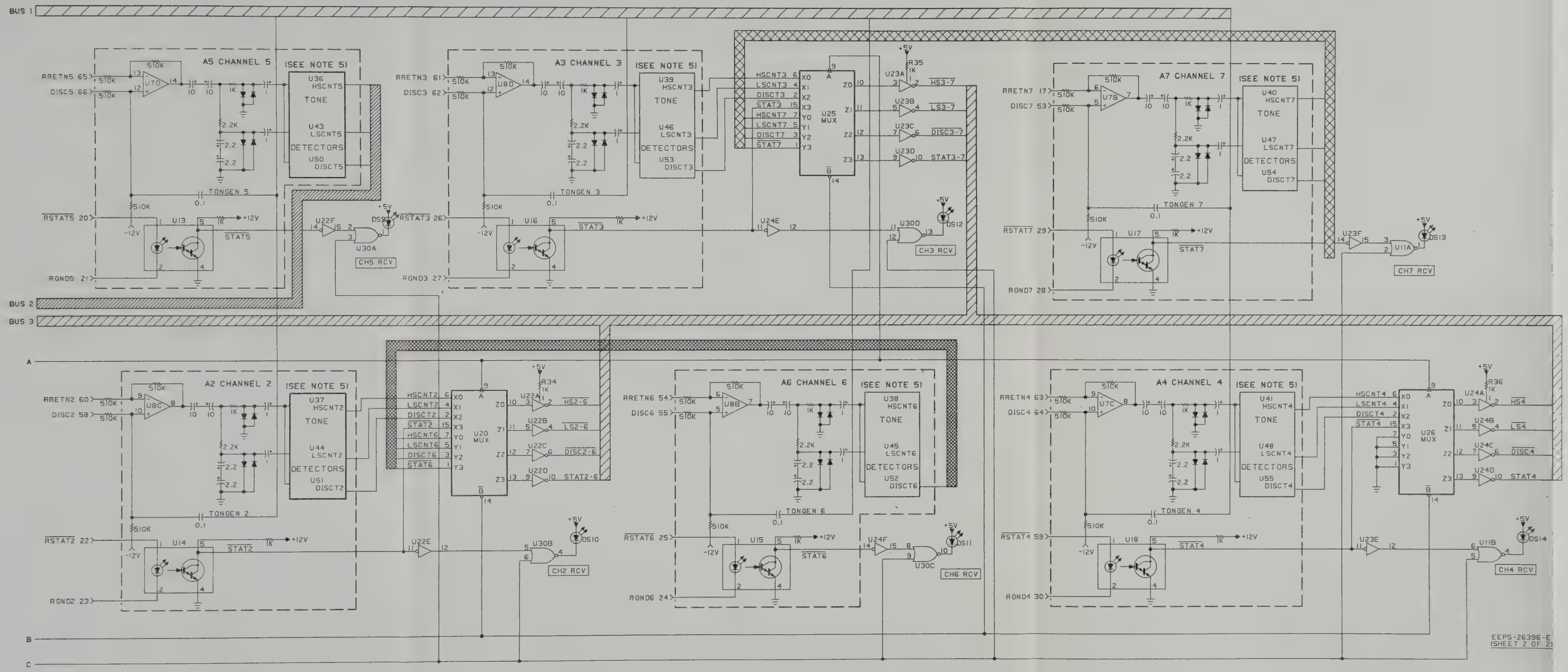
TRN8661A RECEIVER INTERFACE BOARD

BLOCK DIAGRAM, CIRCUIT BOARD DETAIL,
LOGIC DIAGRAM, AND PARTS LIST



CHANNEL DISABLE LIGHTS
TONE TEST DECODER
8 CHANNEL ANALOG MUX
BUS 1
BUS 2
BUS 3
U1 BUS RCVR DRVR
U2 BUS RCVR DRVR
U3 BUS RCVR
U4 BUS RCVR
U9 PIA 8020 8023 8040 8043 (8D21) 8080 8083 (8D31)
U10 PIA 8024 8027 8044 8047 (8D21) 8084 8087 (8D31)
CHANNEL DISABLE PUSH BUTTONS
TONES
U29
TONGEN 4
TONGEN 7
TONGEN 3
TONGEN 6
TONGEN 2
TONGEN 5
TONGEN 1
(SEE NOTE 5)
TONE DETECTORS
U35 HIGH SPEED
U42 LOW SPEED
U49 DISCONNECT
AI CHANNEL 1
HSCNT1
LSCNT1
DISCT1
STAT1
U19 MUX
HSI-5
LSI-5
DISCI-5
STAT1-5
RRETN1 56
DISC1 57
RSTAT1 18
RGND1 19
U12
CH1 RCV
A
B
C
EEPS-26396-E (SHEET 1 OF 2)

TRN8661A RECEIVER INTERFACE BOARD
BLOCK DIAGRAM, CIRCUIT BOARD DETAIL, LOGIC DIAGRAM, AND PARTS LIST


BUS 1
BUS 2
BUS 3
A
B
C
A5 CHANNEL 5
A3 CHANNEL 3
A7 CHANNEL 7
A2 CHANNEL 2
A6 CHANNEL 6
A4 CHANNEL 4
(SEE NOTE 5)
RRETN5 65
DISC5 66
RSTAT5 20
RGND5 21
RRETN3 61
DISC3 62
RSTAT3 26
RGND3 27
RRETN7 17
DISC7 53
RSTAT7 29
RGND7 28
RRETN2 60
DISC2 58
RSTAT2 22
RGND2 23
RRETN6 54
DISC6 55
RSTAT6 25
RGND6 24
RRETN4 63
DISC4 64
RSTAT4 59
RGND4 30
U36 HSCNT5 TONE
U43 LSCNT5
DETECTORS
U50 DISCT5
U39 HSCNT3
U46 LSCNT3
U53 DISCT3
U40 HSCNT7
U47 LSCNT7
U54 DISCT7
U37 HSCNT2
U44 LSCNT2
U51 DISCT2
U38 HSCNT6
U45 LSCNT6
U52 DISCT6
U41 HSCNT4
U48 LSCNT4
U55 DISCT4
TONGEN 5
TONGEN 3
TONGEN 7
TONGEN 2
TONGEN 6
TONGEN 4
510K
2.2K
2.2
1K
0.1
-12V
+12V
+5V
STAT5
STAT3
STAT7
STAT2
STAT6
STAT4
U13
U16
U17
U14
U15
U18
U7A
U8D
U7B
U8C
U8B
U7C
U22F
U30A
CH5 RCV
U24E
U30D
CH3 RCV
U23F
U11A
CH7 RCV
U22E
U30B
CH2 RCV
U24F
U30C
CH6 RCV
U23E
U11B
CH4 RCV
DS9
DS12
DS13
DS10
DS11
DS14
U25 MUX
U20 MUX
U26 MUX
HSCNT3
LSCNT3
DISCT3
STAT3
HSCNT7
LSCNT7
DISCT7
STAT7
HSCNT2
LSCNT2
DISCT2
STAT2
HSCNT6
LSCNT6
DISCT6
STAT6
HSCNT4
LSCNT4
DISCT4
STAT4
R35 1K
R34 1K
R36 1K
U23A
U23B
U23C
U23D
U22A
U22B
U22C
U22D
U24A
U24B
U24C
U24D
HS3-7
LS3-7
DISC3-7
STAT3-7
HS2-6
LS2-6
DISC2-6
STAT2-6
HS4
LS4
DISC4
STAT4
EEPS-26396-E
(SHEET 2 OF 2)

NOTES:

1. Unless otherwise indicated: resistor values are in ohms; capacitor values are in microfarads.

2. This diagram shows positive logic:

TTL, LSTTL — [Logic "1" 2 to 5 V dc
Logic "0" 0 to .8 V dc

CMOS ——— [Logic "1" 8.4 to 12 V dc
Logic "0" 0 to 3.6 V dc.

3. Integrated circuits on this board are TTL, LSTTL, and CMOS devices.

4. IC types and connections for this board are as follows:

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U6	74LS20	14	7	Dual 4-In NAND
U7, 8	MC3403	4 (+12 V)	11 (-12 V)	Quad Op-Amp
U9, 10	MC6821	20	1	PIA
U11, 27, 28, 30	74LS33	14	7	Quad 2-In NOR (OC)
U12, 13, 14, 15, 16, 17, 18	4N33	—	—	Opto Isolator
U19, 20, 25, 26	MC14519	16	8	4-Bit And/Or Sel
U21, 22, 23, 24	MC14009	16 (+12 V) 1 (+5 V)	8	Hex Inv/Buf
U29	MC14051	16	7, 8	8-Chan ANL Mux
U31	7406	14	7	Hex Buffer
U34	74LS03	14	7	Quad 2-In NAND (OC)
U35 thru 55	FX105	16 (+12 V)	10	Tone Detector

5. Identical circuits are used for A1 channel 1 through A7 channel 7 except for the circuit board connector input pin numbers and the corresponding operational amplifier pins. Refer to the channel 1 parts list for discrete components.

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   U7A, pins 2 & 3 are tied to gnd.
   U21E, pin 11 is tied to +12 V
   U31A, B, C, F, pins 1, 3, 5, & 13 are pulled up to +5 V thru a 1k resistor.
   U34A, B, D, pins 1, 2, 4, 5, 12, & 13 are pulled up to +5 V thru a 1k resistor.

7. IC's U21, 22, 23, 24 have CMOS logic level inputs and TTL logic level outputs.

MOTOROLA INC.
*Communications
Sector*

TRANSMITTER INTERFACE BOARD MODULE

MODEL TRN8663A

1. INTRODUCTION

The TRN8663A Transmitter Interface Board (TIB) module receives the MPU ADDRESS and DATA BUS signals from the transmitter site controller (TSC) and changes them into data and control signals that can be used by the Trunked Radio System base repeater transmitters. Since each TIB can control up to seven transmitters, three TIB modules are required for a system employing twenty channels.

2. FUNCTIONAL DESCRIPTION

2.1 SIGNAL BUFFERS

Inverting buffer U1 receives the $\overline{A0}$, $\overline{A1}$, $\overline{A2}$, $\overline{A5}$, $\overline{A8}$, and R/W signals at pins 1, 3, 5, 15, 13 and 11, respectively. Signals 02, ADEC, RESET, LPTST, and 3600 appear at pins 5, 3, 1, 15, and 13, respectively, of Inverting Buffer U2. Bidirectional Buffer U3 receives data signal D0 through D3, and U4 receives data signals D4 through D7. (An explanation of all the input signals to this board is presented in the Site Controller Board instruction section of this manual.) A0 appears at U1-2 and is fed to PIA's U7 (pin 36) and U8 (pin 35). A1 appears at U1-4 and is fed to U7-35 and U8-36. Interchanging the A0 and A1 connections to U8 puts its output registers in adjacent memory locations and permits the transfer of two bytes of information to the U8 outputs with one STORE INDEX or STORE STACK instruction. The A2 signal from U1-6 is connected to the CS2 input of U7-23 but is connected to the CS0 input on U8-22. This permits the selection of U7 when the A2 line is low and the selection of U8 when the A2 line is high. The 02 signal from U2-6 goes to the E input on U7-25 and U8-25 as well as to U6-1 and U6-4. The R/$\overline{W}$ signal from U1-10 goes to the R/$\overline{W}$ inputs on U7-21 and U8-21 as well as to U6-3 and U5-2. The R/$\overline{W}$ signal is high when in the READ mode and low when in the WRITE mode.

2.2 ADDRESS DECODING

2.2.1 Address decoding is required since there are more address lines than there are chip select inputs on the PIAs (U7 and U8). In addition, the bidirectional buffers, U3 and U4, must be switched either to enable data to go from the TSC module to the PIA when data is written into the PIA or to enable data to go from the PIAs to the TSC when data is read from the PIA.

2.2.2 The U6B output goes low only when its three inputs, A5, A8, and ADEC, are high. The output from U6B-8 is fed through U5D to the CS1 inputs on U7-24 and U8-24.

2.2.3 The U6A output goes low when the 02 signal is high and when the R/W signal is in the READ (high) mode. A low signal on U6-6 and U6-8 drives U5-4 high, which in turn drives U3-15 and U4-15 high. A high signal on U3-15 and U4-15 causes these buffers to switch such that data can be read from either PIA (U7 or U8) by the TSC.

2.2.4 When the R/$\overline{W}$ signal is in the WRITE (low) mode, this signal is inverted by U5A and applied as a high signal to U6-13. When the 02 signal on U6C-1 and the output from U5D on U6C-2 go high, U6-12 goes low, driving U3-1 and U4-1 low. A low signal on U3-1 and U4-1 causes both buffers to switch such that data can now be written by the TSC into either PIA (U7 or U8).

2.2.5 Since a trunked system can be provided with up to three TIB modules, each TIB requires its own address. This is done on the central controller backplane by connecting different address lines to edge connector pin 40. For TIB1, edge pin 40 is connected to address line A5. For TIB2, pin 40 is connected to A6. For T1B3, pin 40 is connected to A7.

2.3 PIA U7

2.3.1 The B side of U7 controls the state of the seven yellow LED indicators DS1 through DS7. For example, when PB0 at U7-10 goes high, it drives U68C-9 high, thus causing U68C-10 to go low and DS1 to turn on.

2.3.2 The A side of U7 receives inputs either from the transmitter status or the ENABLE/DISABLE switches. For example, the STAT1 signal (transmitter status from

technical writing services
1301 E. Algonquin Road, Schaumburg, IL 60196

transmitter #1) is received on edge connector pin 28. When transmitter #1 is keyed, the STAT1 signal appears as a high at U15-1, causing U15-5 to go low. This low is applied to inverter U12C (pin 5) and consequently appears as a high voltage at U11-11.

2.3.3 The input from ENABLE/DISABLE switch is high when the switch is in the ENABLE mode and low when it is in the DISABLE mode. For channel 1, this signal comes from S1 and is applied to U11-10.

2.3.4 When the PB7 signal at U7-17 is low, it enables U10 and U11 to select the status inputs and apply them to the A inputs of U7. When in the high state, PB7 causes U10 and U11 to select inputs from the ENABLE/DISABLE switches and apply these signals to the A inputs of U7. For example when U11-1 is low, the signal on pin 11 is switched to output pin 9. When U11-1 is high, the signal on pin 10 is switched to pin 9.

2.4 PIA U8

2.4.1 The U8 outputs are connected to inverters U34 and U35, and the outputs of these inverters are connected to parallel-to-serial converters U41 through U47 as well as to storage registers U48 through U54. U36 is a 4-bit binary counter. The bits at pins 14, 13, and 12 are fed to pins 1, 2, and 3, respectively, of decoder U37. The latter device decodes the 3-line inputs into eight individual output lines. The U37 outputs go to different pairs of the parallel-to-serial converters and to different pairs of the storage registers.

2.4.2 Whenever data is read into the A side of U7, the negative going CA2 pulse is generated on U7-39 that resets U36. When data is written out of the B side of U8, the positive-going CB2 pulse is generated on U8-19 and fed to U36-2 and U37-4. CB2 is a clock pulse for U36 that advances its count by 1 whenever it occurs. On U37, this clock pulse disables U37 for the duration of the pulse while its inputs from U36 are changing state.

2.4.3 A 3600 Hz clock signal from U2-12 is applied to pin 2 of each parallel-to-serial converter (U41-U47). The data in the converters is shifted one stage with each low-to-high transition of this clock.

2.5 DATA AND CONTROL SIGNAL GENERATION

2.5.1 After the initial positive-going transition of the 3600 Hz clock pulse the following occurs. The A side of U7 is read to generate the CA2 pulse which resets U36. The U36 outputs (pins 14, 13, and 12) go low. U37 decodes this information causing its output on pin 15 to go low while all the other outputs remain high. Since U37-15 is connected only to U41 and U44, a low signal on U37-15 causes these two converters to accept signals on their parallel inputs. Information is now written out to both the A and B sides of PIA U8. These signals pass through U34 and U35 and are applied to all the converters, U41 through U47. However, only U41 and U44 retain these signals since only these two converters were previously enabled.

2.5.2 The CB2 pulse from U8-19 now advances U36 from a count of 0 to 1. U37 decodes this information and its output pin 14 goes low while the other outputs remain high.The low signal at U37-14, connected to U42-1 and U45-1, enables these converters to accept the next output signal from U8. Information is fed from U8 to U43, U46, and U47 in a similar fashion. When U36 is set to a count of 4, the output of U37-11 goes low while the other outputs remain high. Output signals from U8 can now be latched only into U48 and U51 since the signal at U37-11 goes only to these two circuits. When U36 is set to a count of 5, output signals from U8 are latched into U49 and U52. Information is latched into U50, U53, and U54 in a similar manner.

2.5.3 During the second through the sixth clock cycles, no information is written out to U8. However, with each negative-to-positive excursion of the clock, information is shifted within U41 through U47 and out of their respective outputs on pin 9. The outputs from U48 through U54 do not change since information has been latched into these circuits. During the seventh cycle of the 3600 Hz clock, signals are again fed from U8 to load information into U41 through U54.

2.6 PTT AND MUTE LINE OUTPUTS

The outputs from U41 through U54 are so arranged that five signals go to each of the seven different channels. These signals are:DATA, PTT, H/L, MUTE, and L/L. For channel 1, data generated on U44-9 is fed through inverter U38D to U62-13. Control lines from U51 are fed to U62, U69D, and U39B. When the PTT control line at U51-2 goes high, U69-13 goes low, causing LED DS8 to turn on. In addition, the signals on U40-8, U14-5, and edge pin 31 also go low. Since edge pin 31 is connected to repeater transmitter #1, a low signal on this pin causes transmitter #1 to transmit. When the MUTE control line at U51-7 goes high, U39B-4 goes low, causing U13-5 to go low. U13-5 is connected to edge pin 30 which goes to the MUTE lead in transmitter #1. A low signal on this line mutes transmitter #1, thus preventing signals received by the station receiver from being retransmitted by the transmitter.

2.7 DATA BAUD RATES

Data is transmitted at three different baud rates — the connect signal is transmitted at 150 baud, the disconnect signal at 300 baud, and the high-speed signal at 3600 baud. Since the board has only one clock signal (3600 Hz), the transmission of the slower baud rates is achieved by writing out data to PIA U8 at the proper times to correspond to the slower baud rate desired. For example, each bit boundary of the 3600 baud data occurs coincidentally with each cycle of the 3600 Hz clock. However, for 300 baud data, each bit boundary occurs every 12 cycles of the 3600 Hz clock.

2.8 DATA FILTERS

For channel 1, U61B and its associated components (C1, C2, C3, R21, R22, and R23) constitute a low-pass filter, with a corner frequency of 95 Hz. U61A and its associated components (C4, C5, C6, R27, R28, and R29) constitute a low-pass filter, with a corner frequency of 190 Hz. An amplifier with a gain of 1.8 is provided by U61C and its associated components (R30, R31, R32, R33). R24, R25, and R26 form an attenuator that reduces its output to 1/3 of its input. The filters for the other channels (2 through 7 per each TIB) operate in a similar manner.

2.9 FILTER CONTROL AND DATA OUTPUT

2.9.1 Data from the output (pin 9) of the parallel-to-serial converters (U41-U47) goes through an inverter and is fed to a demultiplexer where it is switched to the proper filter.

2.9.2 For channel 1, when the input data at U62-13 is a high speed signal, the H/L control signal from U51-5 is set low and applied to U62-9. The data appears at U62-12 and U62-14, passes through U61A, is amplified by U61C, and is fed through edge pin 26 to the DATA input of transmitter #1. When the data input at U62-13 is a disconnect signal, the H/L control signal is set high, and the L/L control signal at U51-10 goes low. A high signal on pin 9 and a low signal on pin 10 of U62 causes the input signal to be switched to U62-15. The disconnect signal passes through U61B, is attenuated to 1/3 of its value by the attenuating network (R24, R25, and R26), is filtered by the 190 Hz low-pass filter, amplified by U61C, and fed via edge pin 26 to the DATA input of the transmitter. When a connect-signal appears at U62-13, both the H/L and L/L control signals are driven high. A high signal on pins 9 and 10 of U62 causes the signal to appear at U62-11. The connect signal is then filtered by the 90 Hz low-pass filter, attenuated to 1/3 of its value, filtered by the 190 Hz low-pass filter, amplified by U61C, and applied via edge pin 26 to the transmitter.

2.9.3 The high-speed signal is not attenuated by the circuitry and is transmitted by the transmitter at a 3 kHz deviation. Since the connect and disconnect signals are attenuated to 1/3 of their original values, both signals are transmitted at a 1 kHz deviation. The filters and control circuits for the other channels (2 through 7 per each TIB) operate in a similar manner.

2.10 FRONT PANEL

Each TIB front panel is provided with a green LED indicator, a yellow LED indicator and a switch for each channel controlled by TIB. When lit, the green LED indicates that the transmitter key lead has been activated to key up the transmitter on the specified channel. The yellow LED, when lit, indicates that the associated channel has been disabled. A channel is disabled by pushing the associated switch to the in position, and is enabled by releasing it into the out position. The switch has no effect, however, unless the key switch on the transmitter site controller is set to the SERVICE position.

PL-6347-C

CRIPTION

uF ±5%; 50 V
stated

0 V

de: (see note)

± 5%; 1/4 W:
stated

utton:
h

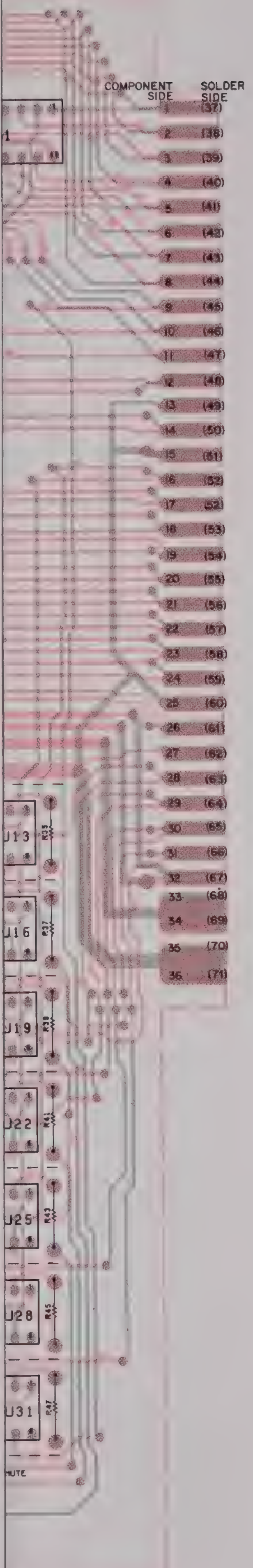
ts: (see note)

etractor

el
9/32"; 3 used
nd-off; 14 used

7 used

nd integrated circuits must

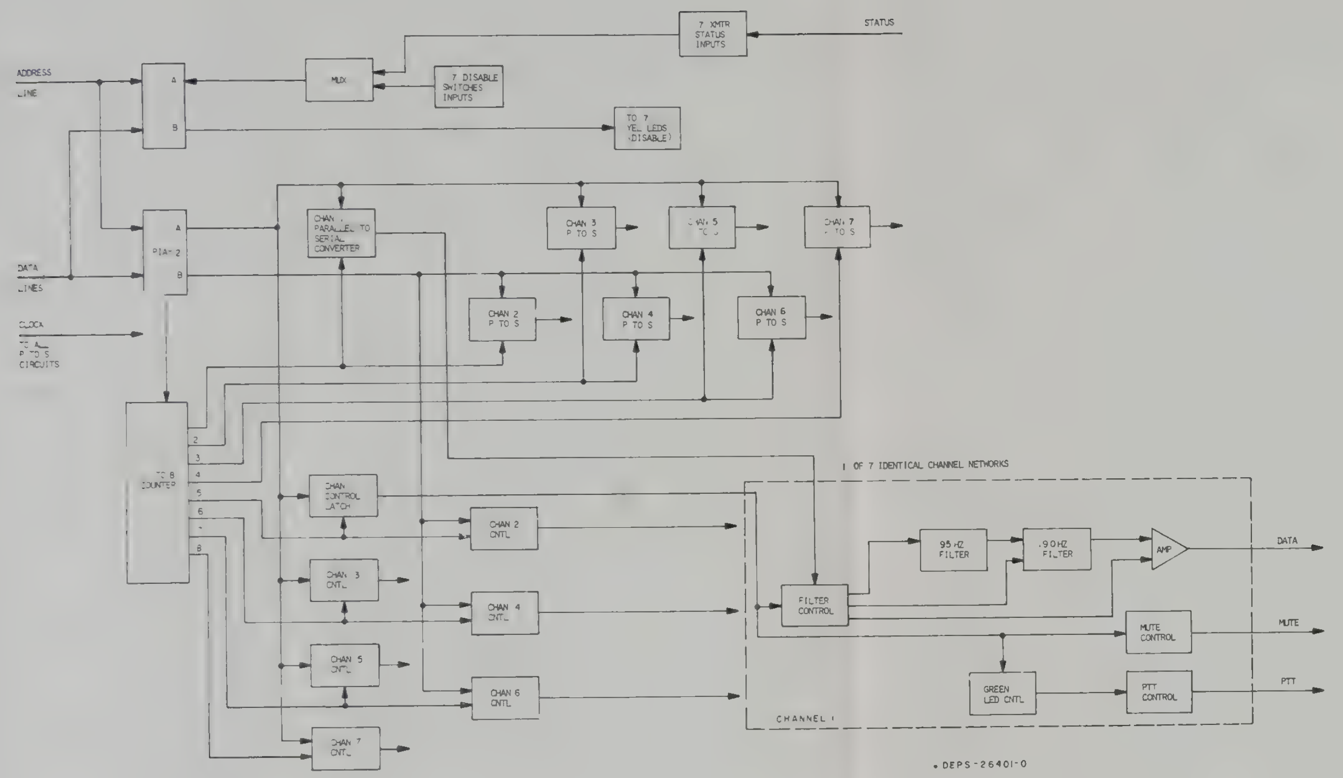

COMPONENT SIDE
SOLDER SIDE
1 (37)
2 (38)
3 (39)
4 (40)
5 (41)
6 (42)
7 (43)
8 (44)
9 (45)
10 (46)
11 (47)
12 (48)
13 (49)
14 (50)
15 (51)
16 (52)
17 (52)
18 (53)
19 (54)
20 (55)
21 (56)
22 (57)
23 (58)
24 (59)
25 (60)
26 (61)
27 (62)
28 (63)
29 (64)
30 (65)
31 (66)
32 (67)
33 (68)
34 (69)
35 (70)
36 (71)
U13
R33
U16
R37
U19
R39
U22
R41
U25
R43
U28
R45
U31
R47
MUTE

TRN8663A TRANSMITTER INTERFACE BOARD

CIRCUIT BOARD DETAIL, LOGIC DIAGRAM, AND PARTS LIST

TRN8663A TRANSMITTER INTERFACE BOARD

CIRCUIT BOARD DETAIL,
LOGIC DIAGRAM,
AND PARTS LIST

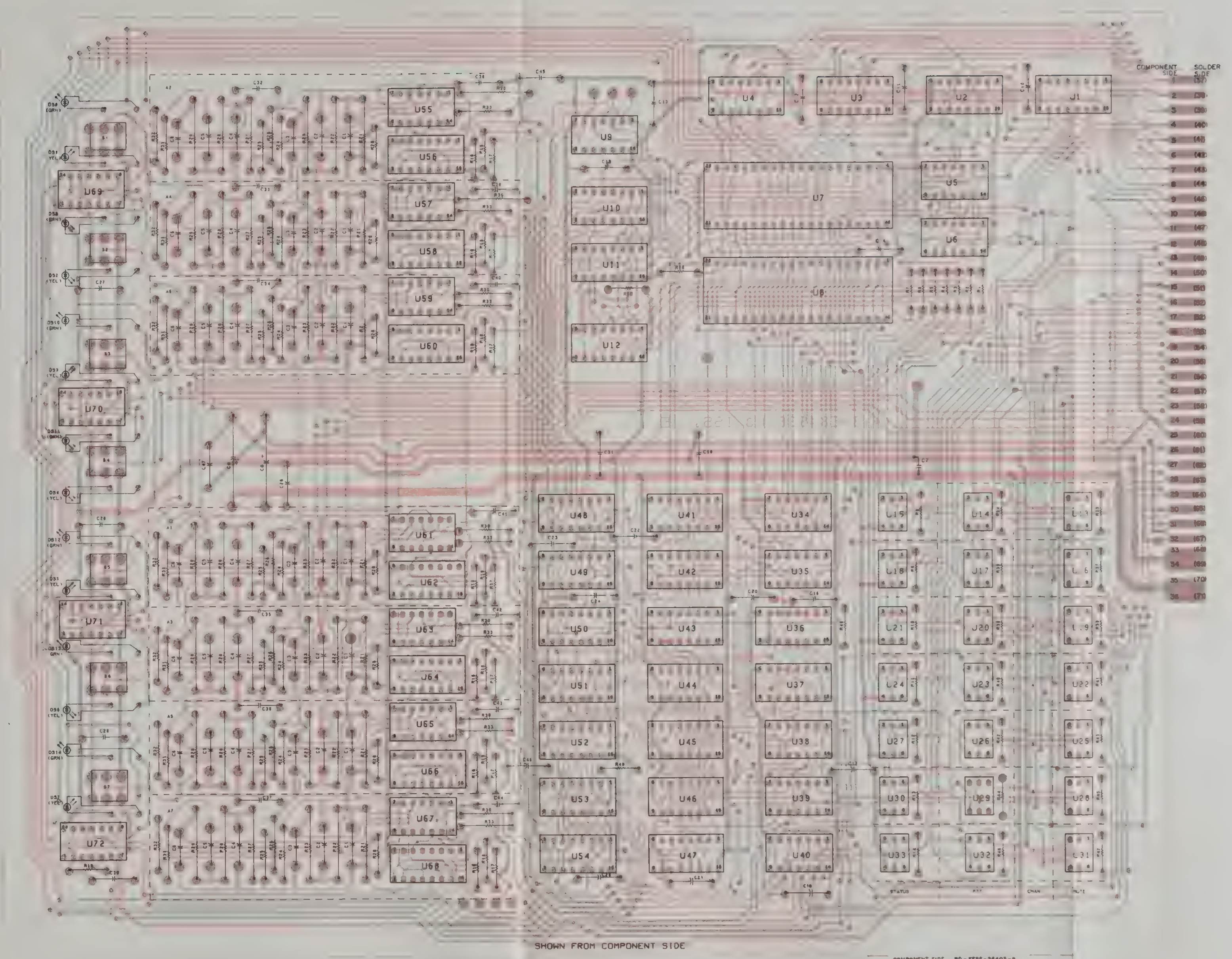

STATUS
7 XMTR STATUS INPUTS
ADDRESS LINE
A
B
MUX
7 DISABLE SWITCHES INPUTS
TO 7 YEL LEDS (DISABLE)
DATA LINES
PIA-2
CLOCK TO ALL P TO S CIRCUITS
CHAN 1 PARALLEL TO SERIAL CONVERTER
CHAN 3 P TO S
CHAN 5 P TO S
CHAN 7 P TO S
CHAN 2 P TO S
CHAN 4 P TO S
CHAN 6 P TO S
1 TO 8 COUNTER
2
3
4
5
6
7
8
CHAN CONTROL LATCH
CHAN 2 CNTL
CHAN 3 CNTL
CHAN 4 CNTL
CHAN 5 CNTL
CHAN 6 CNTL
CHAN 7 CNTL
1 OF 7 IDENTICAL CHANNEL NETWORKS
FILTER CONTROL
95 HZ FILTER
190 HZ FILTER
AMP
DATA
MUTE CONTROL
MUTE
GREEN LED CNTL
PTT CONTROL
PTT
CHANNEL 1
DEPS-26401-0

parts list

TRN8663A Transmitter Interface Board PL-6347-C

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitors, fixed: uF ±5%; 50 V unless otherwise stated
C1	8-83813H25	0082
C2	8-83813H18	02
C3	21-874352	0012, 300 V
C4	8-83813H25	0082
C5	8-83813H18	02
C6	21-874352	0012, 300 V
C7	23-11019A46	100, 20%, 25 V
C8, 9	23-11019A46	100 +150-10%; 20 V
C10 thru 47	21-84448K03	0.1 +80-20%
		light emitting diode: (see note)
DS1 thru 7	48-88245C19	yellow
DS8 thru 14	48-88245C18	green
		resistors, fixed: ±5%; 1/4 W: unless otherwise stated
R1 thru 7	6-11009C73	10k
R8 thru 14	6-11009C58	2 4k
R15	6-11009C49	1k
R16	6-11009C73	10k
R17	6-11009C57	2 2k
R18, 19	6-11009C61	3 3k
R20	6-11009D14	470k
21, 21, 23	6-84640C17	280k ±0.5%
R24	6-83175C97	4 75k ±1%
R25	6-84444A08	2.21k ±1%
R26	6-83175C89	7.5k +1%
R27 thru 30	6-84640C50	143k ±1%
R31	26-83175C19	15.8k ±1%
R32, 33	6-83175C41	28.7k ±1%
R34 thru 47	6-11009C33	220
R48, 49	6-11009C49	1k
		switches, pushbutton:
S1 thru 7	40-84324C17	2-pole, push-push
		integrated circuits: (see note)
U1, 2	51-82609M38	type 8T37
U3, 4	51-84371K77	type 8T26
U5	51-84561L06	type 74LS02
U6	51-84561L08	type 74LS10
U7, 8	51-84561L32	type M6821
U9	51-84371K07	type 7406
U10, 11	51-84561L48	type 74LS157
U12	51-82609M38	type 8T37
U13 thru 33	51-84371K82	type 4N33
U34, 35	51-84561L03	type 74LS04
U36	51-84561L49	type 74LS164
U37	51-84561L41	type 74LS138
U38, 39, 40	51-84371K07	type 7406
U41 thru 47	51-84561L13	type 74LS165
U48 thru 54	51-84561L51	type 74LS165
U55	51-84561L75	MC3403
U56	51-82884L54	type MC14052B
U57	51-84561L75	type MC3403
U58	51-82884L54	type MC14052B
U59	51-84561L75	type MC3403
U60	51-82884L54	type MC14052B
U61	51-84561L75	type MC3403
U62	51-82884L54	type MC14052B
U63	51-84561L75	type MC3403
U64	51-82884L54	type MC14052B
U65	51-84561L75	type MC3403
U66	51-82884L54	type MC14052B
U67	51-84561L75	type MC3403
U68	51-82884L54	type MC14052B
U69 thru 72	51-84561L46	type 74LS33
		mechanical parts
	41-84891F01	SPRING, latch retractor
	55-82239K01	LATCH
	42-84837F01	BEZEL
	61-84989F01	WINDOW, ID label
	3-136890	SCREW 4-40 × 9/32"; 3 used
	14-84891E02	INSULATOR, stand-off; 14 used
	22 84986F01	PIN, latch
	38-84683F01	BUTTON, push; 7 used
	64-84680F08	PANEL, front

note: For optimum performance, diodes, transistors, and integrated circuits must be ordered by Motorola part numbers.

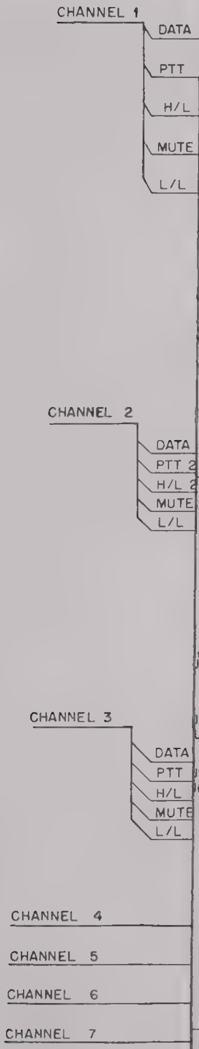

U1
U2
U3
U4
U5
U6
U7
U8
U9
U10
U11
U12
U55
U56
U57
U58
U59
U60
U61
U62
U63
U64
U65
U66
U67
U68
U69
U70
U71
U72
U41
U42
U43
U44
U45
U46
U47
U48
U49
U50
U51
U52
U53
U54
U34
U35
U36
U37
U38
U39
U40
COMPONENT SIDE
SOLDER SIDE
STATUS
CHAN
MUTE

SHOWN FROM COMPONENT SIDE

COMPONENT SIDE BD-EEPS-26403-B
SOLDER SIDE BD-EEPS-26404-B
OL-EEPS-26405-C

TRN8663A TRANSMITTER INTERFACE BOARD

CIRCUIT BOARD DETAIL, LOGIC DIAGRAM, AND PARTS LIST



NLESS OTHERWISE INDICATED:
ESISTOR VALUES ARE IN OHMS
APACITOR VALUES ARE IN MICROFARADS.

HIS DIAGRAM SHOWS POSITIVE LOGIC:
OGIC "1" 2 TO 5 VDC
OGIC "0" 0 TO 0.8 VDC.

HIS BOARD USES TTL AND CMOS
NTEGRATED DEVICES.

HE FOLLOWING TABLE PROVIDES THE REQUIRED
NFORMATION ON THE IC DEVICES.

EFERENCE SIGNATION	TYPE	MFGR'S DESCRIPTION	+5V	GND	V+	+12	-12
U1,U2 U12	8T37	HEX BUS RCVR	16	7,8,9	—		
U3, U4	8T26	QUAD BUS DRIV/RCVR	16	8			
U5	74LS02	QUAD 2-INPUT NOR	14	3,7,8 12			
U6	74LS10	TRIPLE 3-INPUT NAND	14	7	5		
U7, U8	M6821	P1A	20	1,23	22 (V7)		
U38, U39, U40	7406	HEX INVERTER DRIVER OC	14	7			
U10, U11	74LS157	QUAD 2-TO-1 LINE SELECT	16	8,15	13,14, (U11)		
U13-U33	4N33	LED PHOTO DARLINGTON COUPLER	1	4			
U34, U35	74LS04	HEX INVERTER	14	7			
U36	74LS161	4-BIT BINARY COUNTER	16	8	3,4,5, 6,7,9, 10		
U37	74LS138	3-TO-8 DECODER	16	5, 8	6		
,U42,U43,U44, U45,U46,U47	74LS165	8-BIT SHIFT REGISTER	16	8,10, 11,15			
U48-U54	74LS174	HEX D-TYPE FLIP-FLOP	16	8	1,13, 14		
U55,U57,U59, U61,U63,U6, U67	MC3403	QUAD OP AMP DIFF. INPUT				11	4
U56,U58,U60, 62,U64,U66, U68	MC14052B	1-TO-4 SELECTOR	16	6,7,8			
U69-U72	74LS33	QUAD 2-INPUT NOR BUFF OC	14	7			

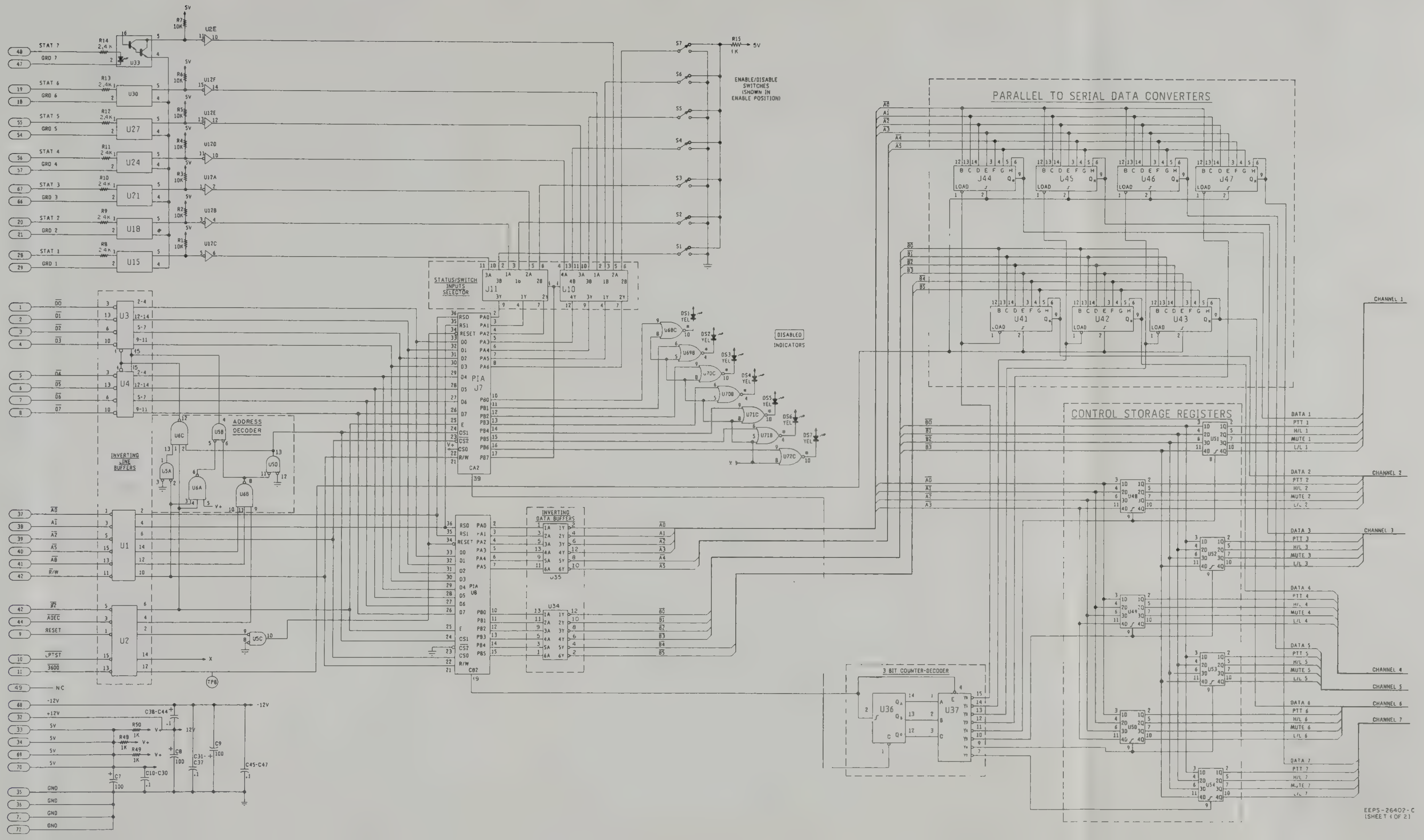
ENTICAL CIRCUITS ARE USED FOR A1-CHANNEL 1
HROUGH A7-CHANNEL 7 EXCEPT FOR THE
IRCUIT BOARD CONNECTOR INPUT PIN NUMBERS
ND THE CORRESPONDING IC PINS. REFER TO
HANNEL 1 PARTS LIST FOR DISCRETE
OMPONENTS.

HE FOLLOWING ARE THE UNUSED GATES:
9D,U9E,U9F
72A,U72B

EEPS-26402-C
(SHEET 2 OF 2)

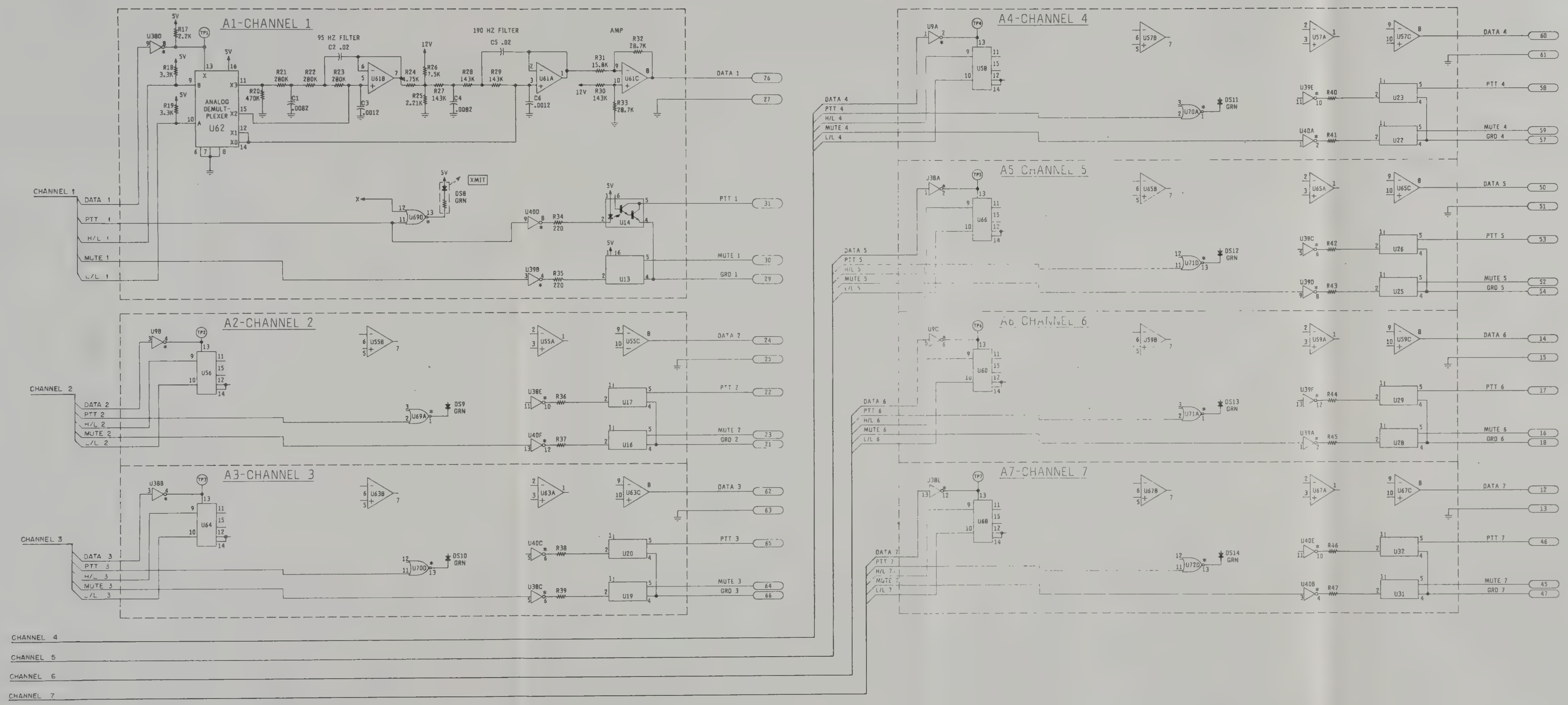
TRN8663A TRANSMITTER INTERFACE BOARD

CIRCUIT BOARD DETAIL,
LOGIC DIAGRAM,
AND PARTS LIST


STAT 7
GRD 7
STAT 6
GRD 6
STAT 5
GRD 5
STAT 4
GRD 4
STAT 3
GRD 3
STAT 2
GRD 2
STAT 1
GRD 1
U33
U30
U27
U24
U21
U18
U15
5V
ENABLE/DISABLE SWITCHES (SHOWN IN ENABLE POSITION)
S7
S6
S5
S4
S3
S2
S1
STATUS/SWITCH INPUTS SELECTOR
J11
U10
PIA J7
PIA U8
DISABLED INDICATORS
DS1 YEL
DS2 YEL
DS3 YEL
DS4 YEL
DS5 YEL
DS6 YEL
DS7 YEL
INVERTING LINE BUFFERS
U3
U4
U1
U2
ADDRESS DECODER
INVERTING DATA BUFFERS
U35
U34
PARALLEL TO SERIAL DATA CONVERTERS
U44
U45
U46
U47
U41
U42
U43
LOAD
CONTROL STORAGE REGISTERS
U51
U48
U52
U49
U53
U50
U54
3 BIT COUNTER-DECODER
U36
U37
RESET
R/W
NC
TP6
-12V
+12V
GND
CHANNEL 1
CHANNEL 2
CHANNEL 3
CHANNEL 4
CHANNEL 5
CHANNEL 6
CHANNEL 7
DATA 1
PTT 1
H/L 1
MUTE 1
L/L 1
EEPS-26402-C (SHEET 1 OF 2)

TRN8663A TRANSMITTER INTERFACE BOARD

CIRCUIT BOARD DETAIL, LOGIC DIAGRAM, AND PARTS LIST


A1-CHANNEL 1
95 HZ FILTER
190 HZ FILTER
AMP
ANALOG DEMULTIPLEXER
U62
XMIT
A2-CHANNEL 2
A3-CHANNEL 3
A4-CHANNEL 4
A5 CHANNEL 5
A6 CHANNEL 6
A7-CHANNEL 7
CHANNEL 1
DATA 1
PTT 1
H/L 1
MUTE 1
L/L 1
CHANNEL 2
CHANNEL 3
CHANNEL 4
CHANNEL 5
CHANNEL 6
CHANNEL 7
GRD 1
GRD 2
GRD 3
GRD 4
GRD 5
GRD 6
GRD 7

NOTES:

1. UNLESS OTHERWISE INDICATED:
   RESISTOR VALUES ARE IN OHMS
   CAPACITOR VALUES ARE IN MICROFARADS.
2. THIS DIAGRAM SHOWS POSITIVE LOGIC:
   LOGIC "1" 2 TO 5 VDC
   LOGIC "0" 0 TO 0.8 VDC.
3. THIS BOARD USES TTL AND CMOS INTEGRATED DEVICES.
4. THE FOLLOWING TABLE PROVIDES THE REQUIRED INFORMATION ON THE IC DEVICES.

REFERENCE DESIGNATION	TYPE	MFGR'S DESCRIPTION	+5V	GND	V+	+12	-12
U1,U2 U12	8T37	HEX BUS RCVR	16	7,8,9	—		
U3, U4	8T26	QUAD BUS DRIV/RCVR	16	8			
U5	74LS02	QUAD 2-INPUT NOR	14	3,7,8 12			
U6	74LS10	TRIPLE 3-INPUT NAND	14	7	5		
U7, U8	M6821	PIA	20	1,23	22 (V7)		
U9, U38, U39, U40	7406	HEX INVERTER DRIVER OC	14	7			
U10, U11	74LS157	QUAD 2-TO-1 LINE SELECT	16	8,15	13,14, (U11)		
U13-U33	4N33	LED PHOTO DARLINGTON COUPLER	1	4			
U34, U35	74LS04	HEX INVERTER	14	7			
U36	74LS161	4-BIT BINARY COUNTER	16	8	3,4,5, 6,7,9, 10		
U37	74LS138	3-TO-8 DECODER	16	5, 8	6		
U41,U42,U43,U44, U45,U46,U47	74LS165	8-BIT SHIFT REGISTER	16	8,10, 11,15			
U48-U54	74LS174	HEX D-TYPE FLIP-FLOP	16	8	1,13, 14		
U55,U57,U59, U61,U63,U6, U67	MC3403	QUAD OP AMP DIFF. INPUT				11	4
U56,U58,U60, U62,U64,U66, U68	MC14052B	1-TO-4 SELECTOR	16	6,7,8			
U69-U72	74LS33	QUAD 2-INPUT NOR BUFF OC	14	7			

5. IDENTICAL CIRCUITS ARE USED FOR A1-CHANNEL 1 THROUGH A7-CHANNEL 7 EXCEPT FOR THE CIRCUIT BOARD CONNECTOR INPUT PIN NUMBERS AND THE CORRESPONDING IC PINS. REFER TO CHANNEL 1 PARTS LIST FOR DISCRETE COMPONENTS.
6. THE FOLLOWING ARE THE UNUSED GATES:
   U9D,U9E,U9F
   U72A,U72B

EEPS-26402-C
(SHEET 2 OF 2)

MOTOROLA INC.
Communications
Sector

Asynchronous Communications Board

Model TRN7056A

1. INTRODUCTION

The Asynchronous Communications Board (ACB) has five asynchronous interfaces. Each interface has an independent baud rate control and is compatible with the standard RS-232-C interface. The ACB receives the Microprocessor Unit (MPU) address and data bus signals from the Site Controller Board (SCB). In a *Smartnet II* AMSS System with site Failsoft, the ACB is also used to detect microwave link failure and causes the repeaters at the site to go into the in-cabinet repeat mode.

2. ADDRESSING

The SCB addresses the ACB through the backplane of the card cage. Address lines A0 through A3 and A11 through A15 along with R/W, E, RESET, and the 1843.2-kHz clock are used to control the ACB. Address lines A1 through A3 and A11 through A15 as well as BDSLA are decoded on the ACB and are used as chip selects. Address lines A0 and A1 select the different registers for the ACIAs, buffers, and PIA. The ACB addresses are listed in Tables 1 and 2:

Table 1. ACB1 Addresses

ACB1	Address	Interface
ACIA1	**$8810–$8811**	**11**
ACIA2	**$8812–$8813**	**12**
ACIA3	**$8814–$8815**	**13**
ACIA4	**$8816–$8817**	**14**
ACIA5	**$8818–$8819**	**15**
RI+DSR Buffer	**$881A**	
DSR+IRQ Buffer	**$881B**	
PIA	**$881C–$881F**	

Table 2. ACB2 Addresses

ACB2	Address	Interface
ACIA1	**$8820–$8821**	**21**
ACIA2	**$8822–$8823**	**22**
ACIA3	**$8824–$8825**	**23**
ACIA4	**$8826–$8827**	**24**
ACIA5	**$8828–$8829**	**25**
RI+DSR Buffer	**$882A**	
DSR+IRQ Buffer	**$882B**	
PIA	**$882C–$882F**	

3. BOARD SETTINGS

The jumpers used for setting the baud rates of ACIA1 through ACIA5 are shown in Table 3. Those for selecting the ACB mode of operation are shown in Table 4.

Table 3. ACIA Baud Rate Control

JU101	Baud Rate, ACIA1
JU102	Baud Rate, ACIA2
JU103	Baud Rate, ACIA3
JU104	Baud Rate, ACIA4
JU105	Baud Rate, ACIA5

Table 4. ACB Operation Mode Control

ACB/AMSS	
JU201–A	Normal ACB
JU201–B	AMSS site Failsoft
JU202–A	Normal ACB
JU202–B	AMSS site Failsoft
JU203–A	AMSS site Failsoft with microwave link or Normal ACB
JU203–B	AMSS without microwave link

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technical writing services
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4. FUNCTIONAL DESCRIPTION

4.1 ASYNCHRONOUS COMMUNICATIONS BOARD

Address and control signals are received by buffers U1 and U2. Data is transceived by U4. The address is decoded by U9, U10, and U11, which select the appropriate Asynchronous Communications Interface Adapter (ACIA) (see address table). RS–232–C signals come in and go out through each ACIA, U7, U15, and the PIA. The ACIA translates the data from the bus to RS–232–C signals or from RS–232–C signals to bus data, depending on the state of the R/W line. The baud rate of each ACIA is controlled by U16. Jumpers JU101, JU102, JU103, JU104, and JU105 enable each ACIA to have its own specific baud rate. The Peripheral Interface Adapter (PIA) is used to control the LEDs and switches. It is also used to detect Data Set Ready (DSR) and generate Data Terminal Ready (DTR). See Figure 1 for a block diagram of the ACB.

4.2 FRONT PANEL INDICATORS AND SWITCHES

Each interface has three LEDs and a pushbutton associated with it. Each ACB has five interfaces.

When lit, the Ready LED (GRN) indicates that communication is currently in process for that interface. When off, the Ready LED indicates that no communication is in progress.

When lit, the Disabled LED (YEL) indicates that communication for that interface is disabled. When off, the Disabled LED indicates that the interface is currently enabled. An interface can be manually disabled by putting the associated switch in the depressed position or can become disabled if the SCB associated with that ACB interface becomes disabled.

The Error LED (RED) indicates for two types of error: for failures that occur before communication has been established and for loss of communication after communication has been established. If an ACB interface is enabled but no modem is attached to the associated port, the associated Error LED flashes at a constant rate, which indicates that this interface is not capable of communicating. If the Error LED lights steadily while an interface is enabled, this indicates that there is a modem available but communication is not in progress.

4.3 AMSS FAILSOFT CIRCUIT

With jumpers JU201 and JU202 in the B position (the A position is for ACB operation in a non–AMSS system or in an AMSS system without site Failsoft), the ACB is used to monitor the status of the microwave link.

In its normal state, the E lead is grounded. When PA5 of the PIA (U37) is low, pin 3 of U202 is high, keeping Q201 off and pin 60 high (pulled up by the repeater). This means that the repeater is in the trunking mode.

When the microwave link (connected to edge–connector pin 31) fails , the microwave relays open, which causes the E lead to float. R201 provides a pull–up that causes pin 1 of U202 to go high, forcing pin 3 of U202 low, which turns Q201 on. The contacts of relay K201 close, causing edge–connector pin 60 to go from a floating state to a grounded state. This causes the repeaters to go into the in–cabinet repeat mode. This information is then routed back through the RI3 line to U15 (address location $881A). The in–cabinet repeat mode can also be triggered through software by changing the value at address location $881C (changing the level of PA5 of the PIA). PA5 in a low state also causes activation of the in–cabinet repeat mode.

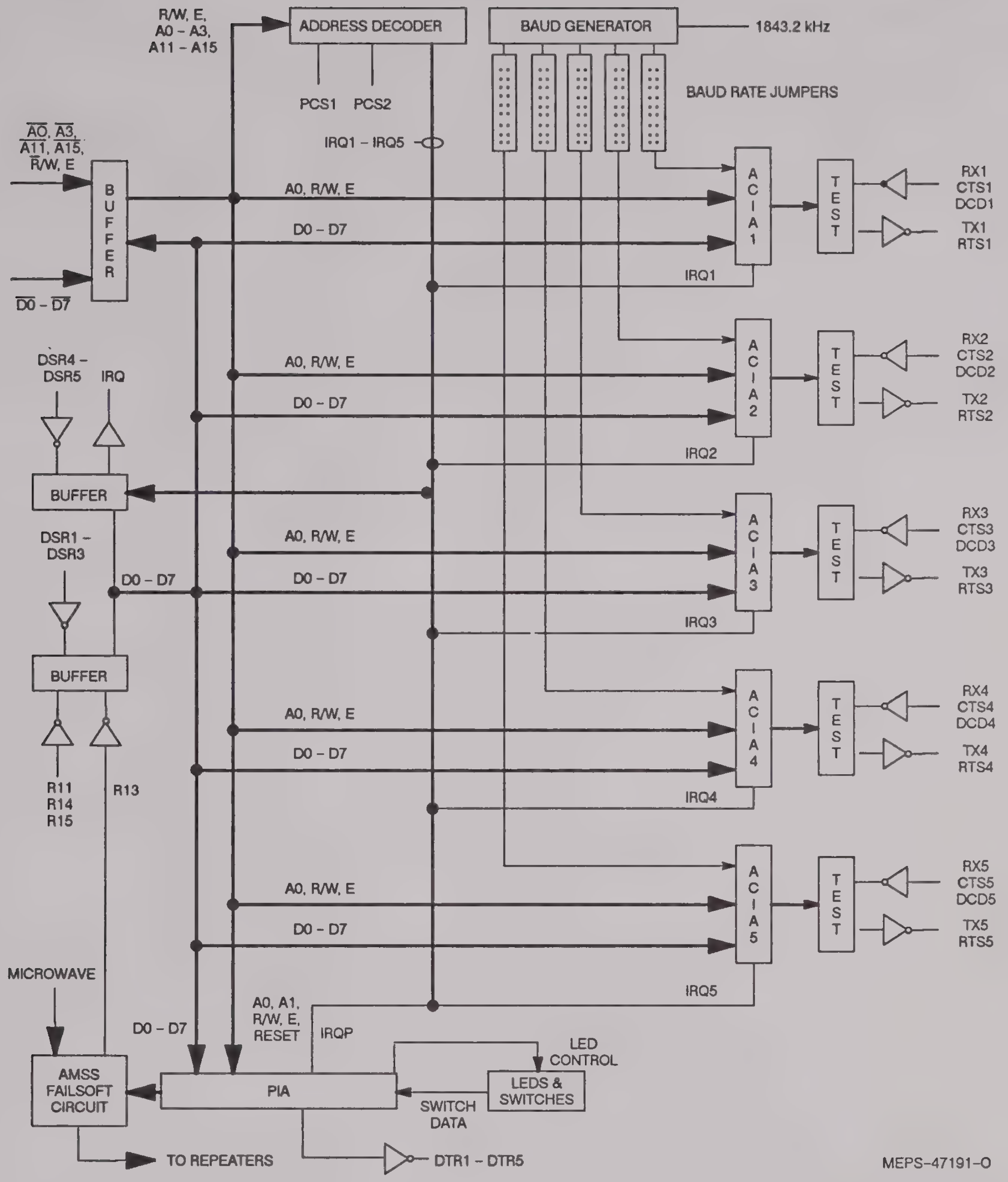

R/W, E,
A0 – A3,
A11 – A15
ADDRESS DECODER
BAUD GENERATOR
1843.2 kHz
PCS1
PCS2
BAUD RATE JUMPERS
IRQ1 – IRQ5
A0, A3,
A11, A15,
R/W, E
BUFFER
D0 – D7
A0, R/W, E
D0 – D7
ACIA 1
ACIA 2
ACIA 3
ACIA 4
ACIA 5
TEST
IRQ1
IRQ2
IRQ3
IRQ4
IRQ5
RX1
CTS1
DCD1
TX1
RTS1
RX2
CTS2
DCD2
TX2
RTS2
RX3
CTS3
DCD3
TX3
RTS3
RX4
CTS4
DCD4
TX4
RTS4
RX5
CTS5
DCD5
TX5
RTS5
DSR4 –
DSR5
IRQ
BUFFER
DSR1 –
DSR3
D0 – D7
BUFFER
R11
R14
R15
R13
MICROWAVE
D0 – D7
A0, A1,
R/W, E,
RESET
IRQP
LED
CONTROL
AMSS
FAILSOFT
CIRCUIT
PIA
LEDS &
SWITCHES
SWITCH
DATA
TO REPEATERS
DTR1 – DTR5
MEPS–47191–O

Figure 1 ACB Block Diagram

TRN7056A ASYNCHRONOUS COMMUNICATIONS BOARD

CIRCUIT BOARD DETAIL, SCHEMATIC DIAGRAM, AND PARTS LIST

	DESCRIPTION
	2-input NOR buffer 2-input AND gates 2-input NOR buffer 2-input AND gates 2-input NOR buffer -MOS driver OR gate
	g: 4-40 × 5/16; 2 used female: for JU101-105 female: for JU 201-203 andoff switch: 10 used for 5 used for SW1-5 de

and integrated circuits must

SOLDER SIDE

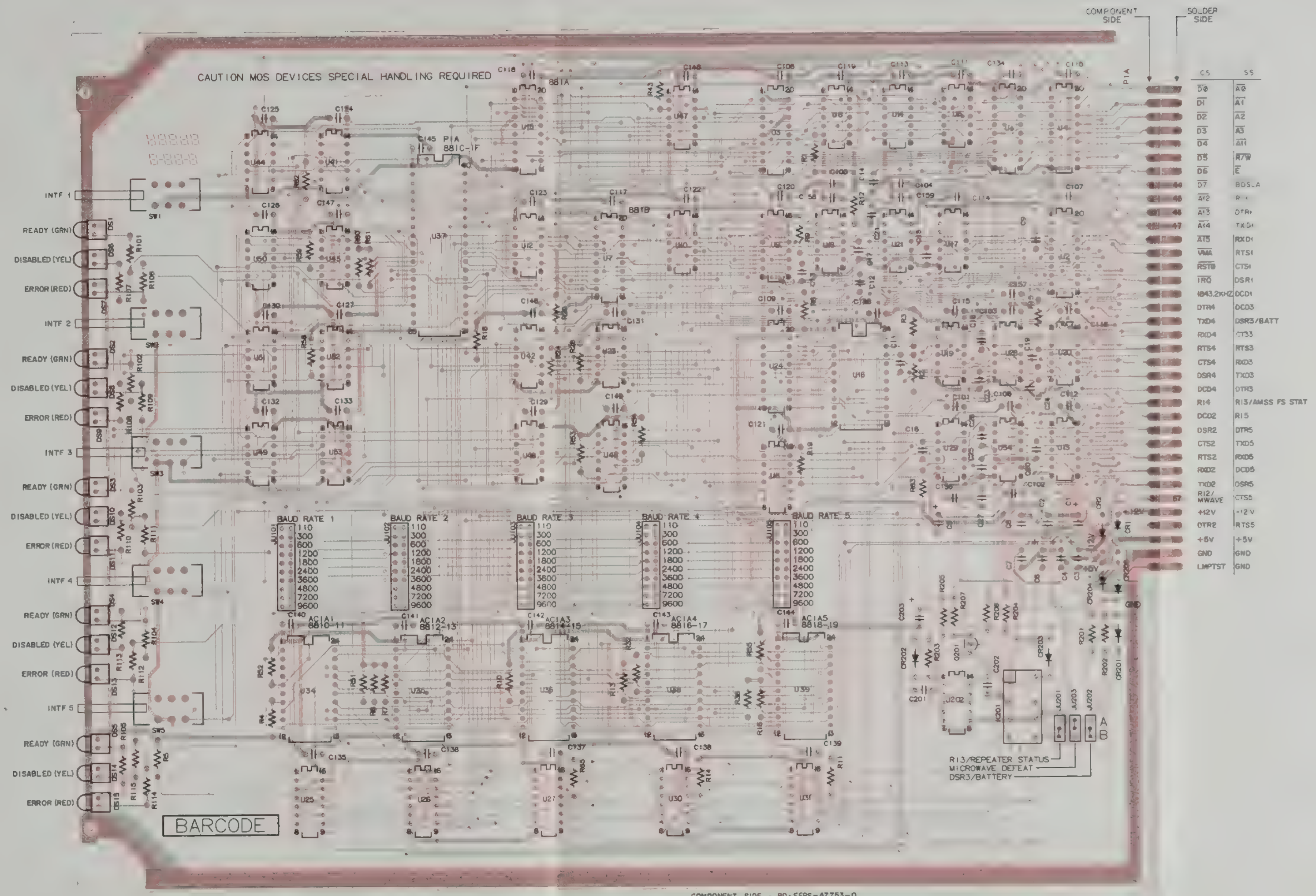
	CS	SS
37	$\overline{D0}$	$\overline{A0}$
38	$\overline{D1}$	$\overline{A1}$
39	$\overline{D2}$	$\overline{A2}$
40	$\overline{D3}$	$\overline{A3}$
41	$\overline{D4}$	$\overline{A11}$
42	$\overline{D5}$	$\overline{R/W}$
43	$\overline{D6}$	$\overline{E}$
44	$\overline{D7}$	$\overline{BDSLA}$
45	$\overline{A12}$	RI1
46	$\overline{A13}$	DTR1
47	$\overline{A14}$	TXD1
48	$\overline{A15}$	RXD1
49	$\overline{VMA}$	RTS1
50	$\overline{RST0}$	CTS1
51	$\overline{IRQ}$	DSR1
52	1843.2KHZ	DCD1
53	DTR4	DCD3
54	TXD4	DSR3/BATT
55	RXD4	CT33
56	RTS4	RTS3
57	CTS4	RXD3
58	DSR4	TXD3
59	DCD4	DTR3
60	RI4	RI3/AMSS FS STAT
61	DCD2	RI5
62	DSR2	DTR5
63	CTS2	TXD5
64	RTS2	RXD5
65	RXD2	DCD5
66	TXD2	DSR5
67	RI2/ MWAVE	CTS5
68	+12V	-12 V
69	DTR2	RTS5
70	+5V	+5V
71	GND	GND
72	LMPTST	GND

parts list

TRN7056A Asynchronous Communications Board (ACB) PL-11442-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitor, fixed: uF ±5% 63V unless otherwise stated
C1	2311019A46	100 20 25V
C2	0811051A13	0.1
C3 thru 6	2311054F10	22 ± 10% 15V
C7 thru 9	0811051A13	0.1
C11	2111014A28	13pF 100V
C12 thru 21	2111015D07	330pF ± 10% 100V
C23 thru 27	2111015D07	330pF ± 10% 100V
C101 thru 149	0811051A13	0.1
C156 thru 159	0811051A13	0.1
C201,202	0811051A13	0 1
C203	2311019A46	100 ± 20% 25V
		diode: (see note)
CR1,2	4882466H13	silicon
CR201,202	4884616A01	hot carrier
CR203	4882466H13	silicon
CR204,205	4882525G23	silicon
		light emitting diode: (see note)
DS1 thru 5	4888245C22	green
DS6	4888245C23	yellow
DS7	4888245C24	red
DS8	4888245C23	yellow
DS9	4888245C24	red
DS10	4888245C23	yellow
DS11	4888245C24	red
DS12	4888245C23	yellow
DS13	4888245C24	red
DS14	4888245C23	yellow
DS15	4888245C24	red
		connector:
JU101 thru 105	2810774A07	male: 20-contact
JU201 thru 203	2810774B02	male: 3-contact
		relay:
K201	8084090N01	2A 5Vdc
		transistor: (see note)
Q201	4800869649	PNP type M9649
		resistor, fixed: ±5% 1/4W
R1	0611009A53	1.5k
R2,3	0611009B22	1 meg
R4 thru 16	0611009A49	1k
R18,19	0611009A49	1k
R20	0611009A73	10k
R24	0611009A73	10k
R28	0611009A73	10k
R32	0611009A73	10k
R36	0611009A73	10k
R43	0611009A73	10k
R51 thru 55	0611009A73	10k
R58 thru 63	0611009A73	10k
R65	0611009A49	1k
R101 thru 115	0611009A39	390
R201	0611009A73	10k
R202	0611009A97	100k
R203 thru 205	0611009A49	1k
R206,207	0611009A73	10k
		switch:
SW1 thru 5	4084324C17	dpdt pushbutton
		integrated circuit: (see note)
U1 thru 3	5184118K78	octal buffer w/3-state outputs
U4	5184810F34	inverted 3-state octal bus transceivers
U6	5184320A90	quad DTL line receiver
U7	5184118K55	octal/line driver w/3-state out buffer
U8	5184084D38	hex buffers/drivers inverter
U9	5182369T04	encoder/decoder
U10	5184118K05	hex inverters
U11	5182369T04	encoder/decoder
U12	5184118K15	quad 2-input positive AND gates
U13,14	5184320A90	quad DTL line receiver
U15	5184118K55	octal/line driver w/3-state out buffer
U16	5182807K14	bit rate generator
U17	5184320A90	quad DTL line receiver
U18	5184320A91	line TTL/DTL-to-MOS driver
U19,20	5184320A90	quad DTL line receiver
U21	5184320A91	line TTL/DTL-to-MOS driver
U23	5184118K29	triple 3-input NAND gates
U24	5184118K78	octal buffer w/3-state outputs
U25 thru 27	5184118K43	2-input quad multiplexer
U28,29	5184320A91	line TTL/DTL-to-MOS driver
U30,31	5184118K43	2-input quad multiplexer
U34 thru 36	5184944N41	1.5MHz ACIA
U37	5184437N40	PIA
U38,39	5184944N41	1.5MHz ACIA
U41	5184118K15	quad 2-input positive AND gates
U42	5184118K05	hex inverters
U44	5184118K15	quad 2-input positive AND gates
U45	5184118K05	hex inverters
U46	5184887K02	non-inverting hex buffer
U47	5184118K05	hex inverters
U48,48	5184118K41	positive quad 2-input NOR buffer
U50	5184118K15	positive quad 2-input AND gates
U51	5184118K41	positive quad 2-input NOR buffer
U52	5184118K15	positive quad 2-input AND gates
U53	5184118K41	positive quad 2-input NOR buffer
U54	5184320A91	line TTL/DTL-to-MOS driver
U202	5184887K09	quad 2-input NOR gate
		non-referenced items
	0300134184	SCREW, locking 4-40 × 5/16, 2 used
	0984728L01	CONNECTOR, female for JU101-105
	0984728L01	CONNECTOR, female for JU 201-203
	1484891E02	INSULATOR, standoff switch: 10 used for SW1-5
	3884683F01	PUSHBUTTON: 5 used for SW1-5
	4184891F01	SPRING
	4282506T01	RETAINER, ID
	5484552P01	LABEL, bar code
	5582239K01	LATCH
	6484680F17	PANEL, front

note: For optimum performance, diodes, transistors, and integrated circuits must be ordered by Motorola part numbers

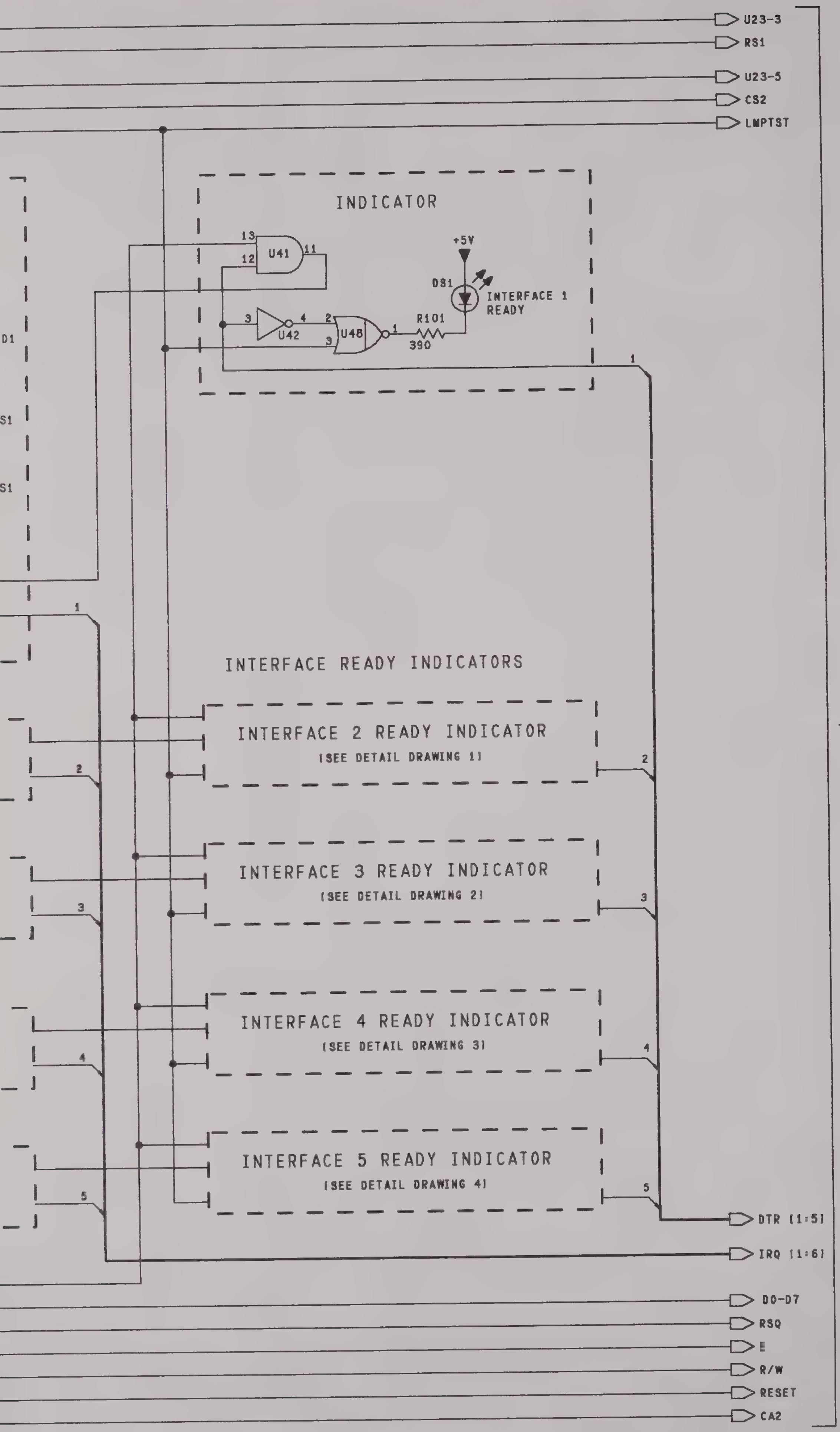

CAUTION MOS DEVICES SPECIAL HANDLING REQUIRED
INTF 1
READY (GRN)
DISABLED (YEL)
ERROR (RED)
INTF 2
READY (GRN)
DISABLED (YEL)
ERROR (RED)
INTF 3
READY (GRN)
DISABLED (YEL)
ERROR (RED)
INTF 4
READY (GRN)
DISABLED (YEL)
ERROR (RED)
INTF 5
READY (GRN)
DISABLED (YEL)
ERROR (RED)
PIA 881C-1F
BAUD RATE 1
BAUD RATE 2
BAUD RATE 3
BAUD RATE 4
BAUD RATE 5
110
300
600
1200
1800
2400
3600
4800
7200
9600
ACIA1 8810-11
ACIA2 8812-13
ACIA3 8814-15
ACIA4 8816-17
ACIA5 8818-19
BARCODE
COMPONENT SIDE
SOLDER SIDE
CS
SS
D0 A0
D1 A1
D2 A2
D3 A3
D4 A11
D5 R/W
D6 E
D7 BDSLA
A12
A13 DTR1
A14 TXD1
A15 RXD1
VMA RTS1
RSTB CTS1
IRQ DSR1
1843.2KHZ DCD1
DTR4 DCD3
TXD4 DSR3/BATT
RXD4 CTS3
RTS4 RTS3
CTS4 RXD3
DSR4 TXD3
DCD4 DTR3
RI4 RI3/AMSS FS STAT
DCD2 RI5
DSR2 DTR5
CTS2 TXD5
RTS2 RXD5
RXD2 DCD5
TXD2 DSR5
RI2/MWAVE CTS5
+12V -12V
DTR2 RTS5
+5V +5V
GND GND
LMPTST GND
RI3/REPEATER STATUS
MICROWAVE DEFEAT
DSR3/BATTERY
A
B

SHOWN FROM COMPONENT SIDE

COMPONENT SIDE - 8D-EEPS-47753-0
SOLDER SIDE - 8D-EEPS-47754-0
OL-EEPS-47755-0

TRN7056A ASYNCHRONOUS COMMUNICATIONS BOARD

CIRCUIT BOARD DETAIL, SCHEMATIC DIAGRAM, AND PARTS LIST

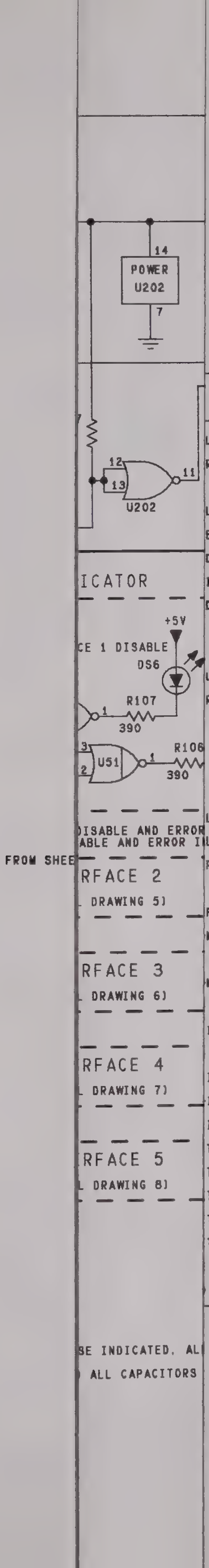

U23-3
RS1
U23-5
CS2
LMPTST
INDICATOR
13
12
U41
11
+5V
DS1
INTERFACE 1
READY
3
4
U42
2
3
U48
1
R101
390
1
D1
S1
S1
1
INTERFACE READY INDICATORS
INTERFACE 2 READY INDICATOR
(SEE DETAIL DRAWING 1)
2
2
INTERFACE 3 READY INDICATOR
(SEE DETAIL DRAWING 2)
3
3
INTERFACE 4 READY INDICATOR
(SEE DETAIL DRAWING 3)
4
4
INTERFACE 5 READY INDICATOR
(SEE DETAIL DRAWING 4)
5
5
TO SHEET 2
DTR (1:5)
IRQ (1:6)
D0-D7
RSQ
E
R/W
RESET
CA2

TEPS-47198-0

SHEET 1 OF 3

TRN7056A ASYNCHRONOUS COMMUNICATIONS BOARD

CIRCUIT BOARD DETAIL, SCHEMATIC DIAGRAM, AND PARTS LIST


14
POWER
U202
7
12
13
11
U202
ICATOR
+5V
CE 1 DISABLE
DS6
R107
1
390
3
2
U51
1
R106
390
ISABLE AND ERROR
ABLE AND ERROR I
FROM SHEE
RFACE 2
L DRAWING 5)
RFACE 3
L DRAWING 6)
RFACE 4
L DRAWING 7)
RFACE 5
L DRAWING 8)
SE INDICATED, AL
ALL CAPACITORS

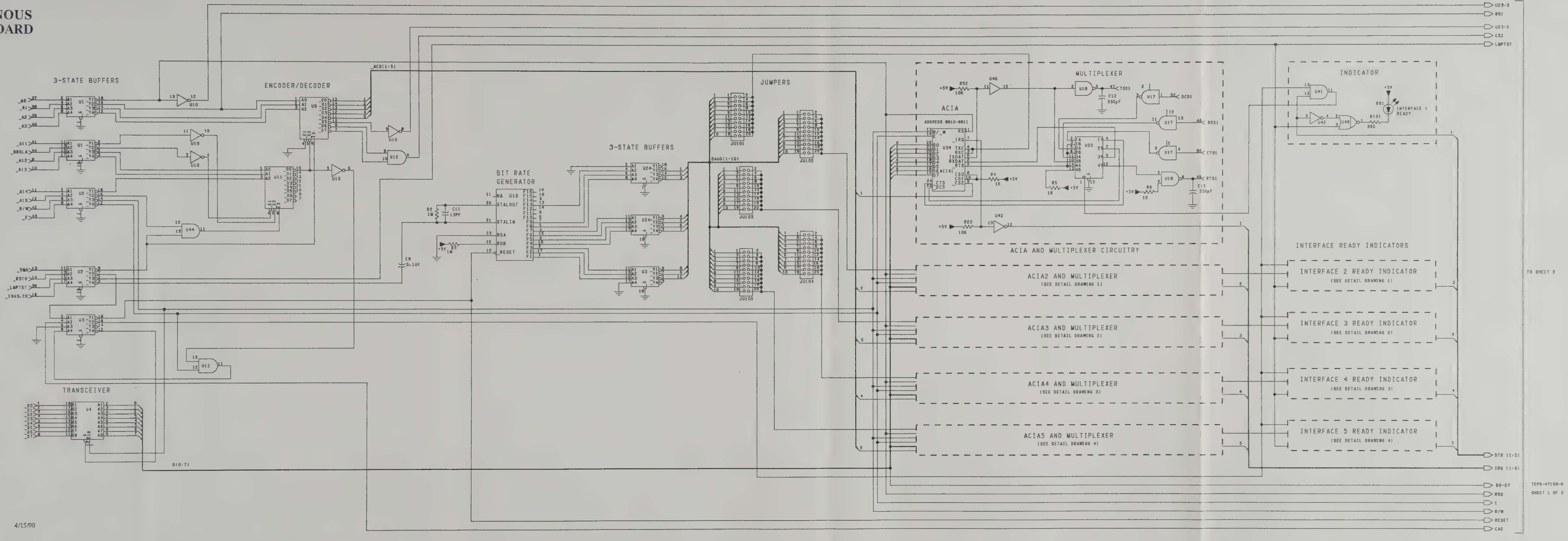
IC POWER CONNECTIONS

MANUFACTURER'S DESCRIPTION	+5V	GND	+12V	-12V
L BUFFER W/3-STATE OUTPUTS	20	10		
RTED 3-STATE OCTAL BUS TRANSCEIVERS	20	1,10,19		
DTL LINE RECEIVER	14	7		
L/LINE DRIVER W/3-STATE OUT BUFFERS	20	10		
BUFFERS/DRIVERS INVERTER	14	7		
DER/DECODER	16	8		
INVERTER	14	7		
DER/DECODER	16	8		
2-INPUT POSITIVE AND GATE	14	7		
DTL LINE RECEIVER	14	7		
L/LINE DRIVER W/3-STATE OUT BUFFER	20	10		
RATE GENERATOR	24	12		
DTL LINE RECEIVER	14	7		
TTL/DTL-TO-MOS DRIVER	-	7	14	1
DTL LINE RECEIVER	14	7		
TTL/DTL-TO-MOS DRIVER	-	7	14	1
LE 3-INPUT NAND GATE	14	7		
L BUFFER W/3-STATE OUTPUTS	20	10		
PUT QUAD MULTIPLEXER	16	8		
TTL/DTL-TO-MOS DRIVER	-	7	14	1
PUT QUAD MULTIPLEXER	16	8		
MHZ ACIA	12	1		
	20	1		
MHZ ACIA	12	1		
2-INPUT POSITIVE AND GATES	14	7		
INVERTERS	14	7		
2-INPUT POSITIVE AND GATES	14	7		
INVERTERS	14	7		
INVERTING HEX BUFFER	1	8		
INVERTERS	14	7		
TIVE QUAD 2-INPUT NOR BUFFER	14	7		
TIVE QUAD 2-INPUT AND GATES	14	7		
TIVE QUAD 2-INPUT NOR BUFFER	14	7		
TIVE QUAD 2-INPUT AND GATES	14	7		
TIVE QUAD 2-INPUT NOR BUFFER	14	7		
TTL/DTL-TO-MOS DRIVER		7	14	1
2-INPUT NOR GATE	14	7		

TEPS-47198-0
SHEET 2 OF 3

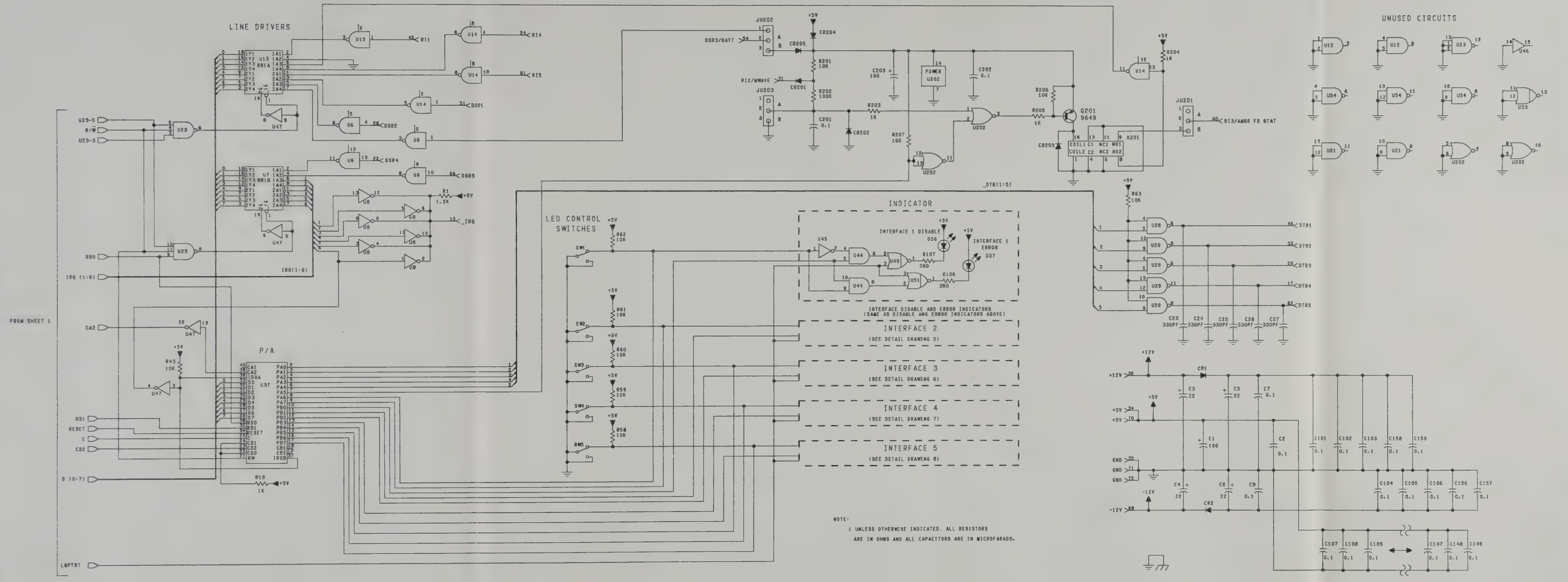
TRN7056A ASYNCHRONOUS COMMUNICATIONS BOARD

CIRCUIT BOARD DETAIL,
SCHEMATIC DIAGRAM,
AND PARTS LIST


3-STATE BUFFERS
ENCODER/DECODER
BIT RATE GENERATOR
3-STATE BUFFERS
JUMPERS
TRANSCEIVER
ACIA
ADDRESS 0810-0811
MULTIPLEXER
INDICATOR
INTERFACE 1 READY
ACIA AND MULTIPLEXER CIRCUITRY
ACIA2 AND MULTIPLEXER
(SEE DETAIL DRAWING 1)
ACIA3 AND MULTIPLEXER
(SEE DETAIL DRAWING 2)
ACIA4 AND MULTIPLEXER
(SEE DETAIL DRAWING 3)
ACIA5 AND MULTIPLEXER
(SEE DETAIL DRAWING 4)
INTERFACE READY INDICATORS
INTERFACE 2 READY INDICATOR
(SEE DETAIL DRAWING 1)
INTERFACE 3 READY INDICATOR
(SEE DETAIL DRAWING 2)
INTERFACE 4 READY INDICATOR
(SEE DETAIL DRAWING 3)
INTERFACE 5 READY INDICATOR
(SEE DETAIL DRAWING 4)
ACS(1:5)
BAUD(1:10)
D(0:7)
U23-3
RS1
U23-5
CS2
LMPTST
DTR (1:5)
IRQ (1:6)
D0-D7
RSQ
E
R/W
RESET
CA2
TO SHEET 2
TEPS-47198-0
SHEET 1 OF 3

TRN7056A ASYNCHRONOUS COMMUNICATIONS BOARD

CIRCUIT BOARD DETAIL,
SCHEMATIC DIAGRAM,
AND PARTS LIST

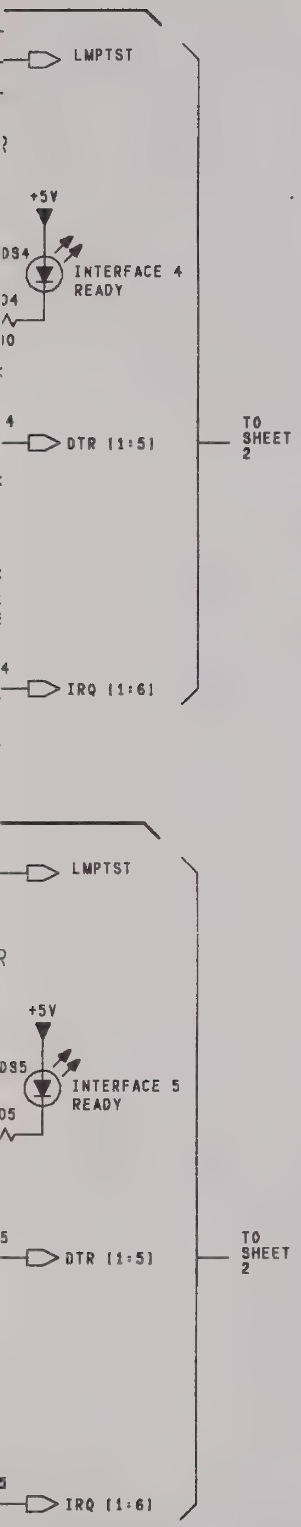

LINE DRIVERS
U15 881A
U7 881B
U13
U14
RI1
RI4
RI5
DSR1
DSR2
DSR3
DSR4
DSR5
U47
U23
U25-5
R/W
U25-3
RSO
IRQ (1:6)
IRQ(1:6)
FROM SHEET 1
CA2
P/A
U37
RS1
RESET
E
CS2
D (0:7)
LWPTST
_IRQ
R1 1.5K
R43 10K
R18 1K
+5V
LED CONTROL SWITCHES
SW1
SW2
SW3
SW4
SW5
R62 10K
R61 10K
R60 10K
R59 10K
R58 10K
INDICATOR
INTERFACE 1 DISABLE
INTERFACE 1 ERROR
DS6
DS7
U45
U44
U49
U51
R107 390
R106 390
INTERFACE DISABLE AND ERROR INDICATORS (SAME AS DISABLE AND ERROR INDICATORS ABOVE)
INTERFACE 2 (SEE DETAIL DRAWING 5)
INTERFACE 3 (SEE DETAIL DRAWING 6)
INTERFACE 4 (SEE DETAIL DRAWING 7)
INTERFACE 5 (SEE DETAIL DRAWING 8)
JU202
JU203
JU201
DSR3/BATT
RI2/WMAVE
CR204
CR205
CR201
CR202
CR203
R201 10K
R202 100K
R203 1K
R205 1K
R206 10K
R207 10K
C201 0.1
C202 0.1
C203 100
POWER U202
U202
Q201 9649
K201
RI3/AMGE FS STAT
R204 1K
R63 10K
_DTR(1:5)
U28
U29
DTR1
DTR2
DTR3
DTR4
DTR5
C23 330PF
C24 330PF
C25 330PF
C26 330PF
C27 330PF
+12V
-12V
GND
CR1
CR2
C1 100
C2 0.1
C3 22
C4 22
C5 22
C6 22
C7 0.1
C8 0.1
C101
C102
C103
C104
C105
C106
C107
C108
C109
C147
C148
C149
C156
C157
C158
C159
UNUSED CIRCUITS
U12
U23
U46
U54
U53
U21
U202

NOTE:
1 UNLESS OTHERWISE INDICATED, ALL RESISTORS ARE IN OHMS AND ALL CAPACITORS ARE IN MICROFARADS.

IC POWER CONNECTIONS

REFERENCE DESIGNATION	MANUFACTURER'S DESCRIPTION	+5V	GND	+12V	-12V
U1 THRU U3	OCTAL BUFFER W/3-STATE OUTPUTS	20	10		
U4	INVERTED 3-STATE OCTAL BUS TRANSCEIVERS	20	1,10,19		
U6	QUAD DTL LINE RECEIVER	14	7		
U7	OCTAL/LINE DRIVER W/3-STATE OUT BUFFERS	20	10		
U8	HEX BUFFERS/DRIVERS INVERTER	14	7		
U9	ENCODER/DECODER	16	8		
U10	HEX INVERTER	14	7		
U11	ENCODER/DECODER	16	8		
U12	QUAD 2-INPUT POSITIVE AND GATE	14	7		
U13,U14	QUAD DTL LINE RECEIVER	14	7		
U15	OCTAL/LINE DRIVER W/3-STATE OUT BUFFER	20	10		
U16	BIT RATE GENERATOR	24	12		
U17	QUAD DTL LINE RECEIVER	14	7		
U18	LINE TTL/DTL-TO-MOS DRIVER	-	7	14	1
U19,U20	QUAD DTL LINE RECEIVER	14	7		
U21	LINE TTL/DTL-TO-MOS DRIVER	-	7	14	1
U23	TRIPLE 3-INPUT NAND GATE	14	7		
U24	OCTAL BUFFER W/3-STATE OUTPUTS	20	10		
U25 THRU U27	2-INPUT QUAD MULTIPLEXER	16	8		
U28,U29	LINE TTL/DTL-TO-MOS DRIVER	-	7	14	1
U30,U31	2-INPUT QUAD MULTIPLEXER	16	8		
U34 THRU U36	1.5-MHZ ACIA	12	1		
U37	PIA	20	1		
U38,U39	1.5-MHZ ACIA	12	1		
U41	QUAD 2-INPUT POSITIVE AND GATES	14	7		
U42	HEX INVERTERS	14	7		
U44	QUAD 2-INPUT POSITIVE AND GATES	14	7		
U45	HEX INVERTERS	14	7		
U46	NON-INVERTING HEX BUFFER	1	8		
U47	HEX INVERTERS	14	7		
U48,U49	POSITIVE QUAD 2-INPUT NOR BUFFER	14	7		
U50	POSITIVE QUAD 2-INPUT AND GATES	14	7		
U51	POSITIVE QUAD 2-INPUT NOR BUFFER	14	7		
U52	POSITIVE QUAD 2-INPUT AND GATES	14	7		
U53	POSITIVE QUAD 2-INPUT NOR BUFFER	14	7		
U54	LINE TTL/DTL-TO-MOS DRIVER		7	14	1
U202	QUAD 2-INPUT NOR GATE	14	7		

TEPS-47198-0
SHEET 2 OF 3


LMPTST
+5V
DS4
INTERFACE 4 READY
DTR [1:5]
TO SHEET 2
IRQ [1:6]
LMPTST
+5V
DS5
INTERFACE 5 READY
DTR [1:5]
TO SHEET 2
IRQ [1:6]

TEPS-47198-0
SHEET 3 OF 3

MOTOROLA INC.
Communications
Sector

SITE INTERFACE BOARD

Model TRN7124A

1. DESCRIPTION OF SITE INTERFACE BOARD

The Site Interface Board (SIB) provides an interface between the AMSS Central Controller and the outside world. The SIB allows the Central Controller to monitor the status of up to five inputs and control five dry relay contact outputs. See Figure 1 for a block diagram of the SIB. The SIB also contains five front panel switches. The Central Controller may read the status of any of these switches. The SIB also contains 15 front panel LEDs that are controllable by the Central Controller. The front panel is arranged so that each switch is grouped with three LEDs. The five switches are labeled Interface 1 thru Interface 5. Each switch has three LEDs associated with it, a green LED labeled READY, a yellow LED labeled DISABLE, and a red LED labeled ERROR. These are shown as R, D, and E, respectively, in Figure 1.

The SIB also contains five circuits that translate an input of ground or –24 volts to a relay contact closure to ground. The output is ground if there is no input. The output is open if power fails.

2. CIRCUIT DESCRIPTION

U1 is the data buffer between the Central Controller and on–board data latches U4, U5, U6, U16, and U17. U2 is the address line buffer that drives the address decoder consisting of U3, U8, U9, and U10.

U4 and U5 act as data latches for the LED drivers. LED drivers U11, U12, U13, and U14 also allow a Lamp Test function controlled by the Lamp Test switch on the Controller Board.

U6 is the data latch for the Relay driver, U15. U15 is a package of Darlington driver transistors. Each transistor has an internal suppression diode wired to pin 9 (+12 V). One set of contacts on each double pole, double throw relay is brought out to the edge connector to interface with the Microwave. The other set of contacts are used to verify the status of the relay. These contacts provide a logic low to data buffer U16 when the relay is activated. U16 is also used to monitor the status of front panel switches S1, S2, and S3. U17 monitors front panel switches S4 and S5. U17 also monitors the status of the on–board power–up reset line (RSET) and the status of the *Spectra–TAC* via comparators U18 and U19.

During power–up or after a reset, the relays are disabled for 15 seconds. This allows the Central Processor time to run its diagnostics and set the relay data latch (U6) to the appropriate state. U7 is an oscillator/timer that is designed to put out a logic high for 15 seconds after power–up or reset. A section of U19 buffers the reset line (RST0) from the Central Controller and converts it from TTL levels to 12 volts. U7 must operate on 12 volts to guarantee automatic reset on power–up. Another section of U19 converts the 12–volt output of U7 to TTL levels and drives the chip disable line on U6.

Relays K6 through K10 are used to interface the microwave status to the *Spectra–TAC* Signal Quality Modules.

3. FUNCTIONAL SPECIFICATIONS

3.1 INPUTS FROM *SPECTRA–TAC*

The inputs from *Spectra–TAC* are on edge connector pins 14, 19, 18, 15, and 17. These inputs are designed to read the status of the Fail line on *Spectra–TAC* or *Digi–TAC*.

The input is terminated with 47 kilohms to ground.

The input switching threshold is set to 6 volts +/– 5% by the resistive divider consisting of R39 and R45. There is an input hysteresis of 0.45 volts.

3.2 INPUTS FROM MICROWAVE M–LEADS

The inputs from the Microwave are on edge connector pins 27, 25, 63, 61, and 51. These inputs are designed to read the status of the M–lead on the Microwave. If the input is between ground and –24 volts, the TAC Disable output relay contacts will be Open.

The input is terminated with a 27–kilohm pull–up to +12 volts.

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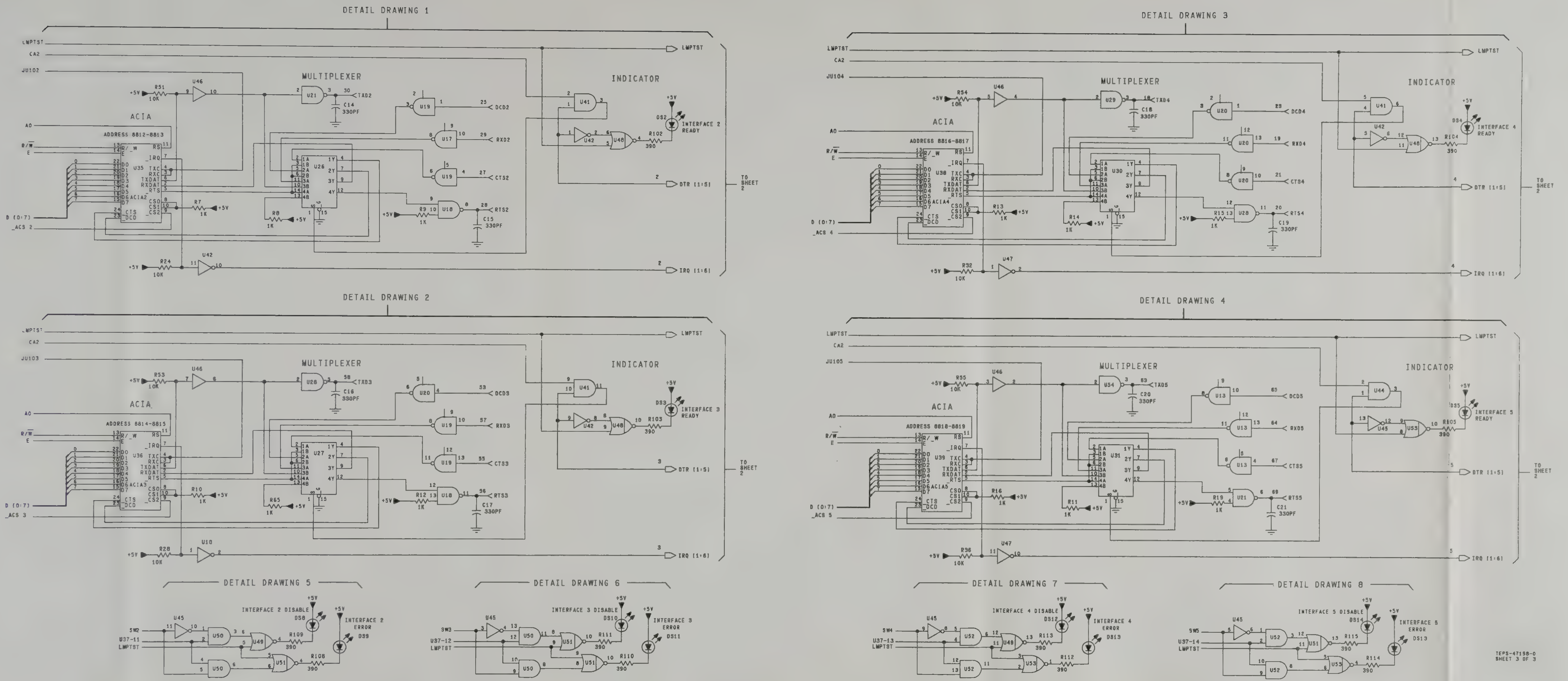
technical writing services
1301 E. Algonquin Road, Schaumburg, IL 60196

TRN7056A ASYNCHRONOUS COMMUNICATIONS BOARD

CIRCUIT BOARD DETAIL,
SCHEMATIC DIAGRAM,
AND PARTS LIST


DETAIL DRAWING 1
MULTIPLEXER
INDICATOR
ACIA
ADDRESS 8812-8813
INTERFACE 2 READY
DETAIL DRAWING 2
MULTIPLEXER
INDICATOR
ACIA
ADDRESS 8814-8815
INTERFACE 3 READY
DETAIL DRAWING 3
MULTIPLEXER
INDICATOR
ACIA
ADDRESS 8816-8817
INTERFACE 4 READY
DETAIL DRAWING 4
MULTIPLEXER
INDICATOR
ACIA
ADDRESS 8818-8819
INTERFACE 5 READY
LMPTST
CA2
D (0-7)
R/W
E
A0
IRQ (1:6)
DTR (1:5)
TO SHEET 2
DETAIL DRAWING 5
INTERFACE 2 DISABLE
INTERFACE 2 ERROR
DETAIL DRAWING 6
INTERFACE 3 DISABLE
INTERFACE 3 ERROR
DETAIL DRAWING 7
INTERFACE 4 DISABLE
INTERFACE 4 ERROR
DETAIL DRAWING 8
INTERFACE 5 DISABLE
INTERFACE 5 ERROR
TEPS-47198-0
SHEET 3 OF 3

MOTOROLA INC.
Communications
Sector

SITE INTERFACE BOARD

Model TRN7124A

1. DESCRIPTION OF SITE INTERFACE BOARD

The Site Interface Board (SIB) provides an interface between the AMSS Central Controller and the outside world. The SIB allows the Central Controller to monitor the status of up to five inputs and control five dry relay contact outputs. See Figure 1 for a block diagram of the SIB. The SIB also contains five front panel switches. The Central Controller may read the status of any of these switches. The SIB also contains 15 front panel LEDs that are controllable by the Central Controller. The front panel is arranged so that each switch is grouped with three LEDs. The five switches are labeled Interface 1 thru Interface 5. Each switch has three LEDs associated with it, a green LED labeled READY, a yellow LED labeled DISABLE, and a red LED labeled ERROR. These are shown as R, D, and E, respectively, in Figure 1.

The SIB also contains five circuits that translate an input of ground or -24 volts to a relay contact closure to ground. The output is ground if there is no input. The output is open if power fails.

2. CIRCUIT DESCRIPTION

U1 is the data buffer between the Central Controller and on-board data latches U4, U5, U6, U16, and U17. U2 is the address line buffer that drives the address decoder consisting of U3, U8, U9, and U10.

U4 and U5 act as data latches for the LED drivers. LED drivers U11, U12, U13, and U14 also allow a Lamp Test function controlled by the Lamp Test switch on the Controller Board.

U6 is the data latch for the Relay driver, U15. U15 is a package of Darlington driver transistors. Each transistor has an internal suppression diode wired to pin 9 (+12 V). One set of contacts on each double pole, double throw relay is brought out to the edge connector to interface with the Microwave. The other set of contacts are used to verify the status of the relay. These contacts provide a logic low to data buffer U16 when the relay is activated. U16 is also used to monitor the status of front panel switches S1, S2, and S3. U17 monitors front panel switches S4 and S5. U17 also monitors the status of the on-board power-up reset line (RSET) and the status of the *Spectra–TAC* via comparators U18 and U19.

During power-up or after a reset, the relays are disabled for 15 seconds. This allows the Central Processor time to run its diagnostics and set the relay data latch (U6) to the appropriate state. U7 is an oscillator/timer that is designed to put out a logic high for 15 seconds after power-up or reset. A section of U19 buffers the reset line (RST0) from the Central Controller and converts it from TTL levels to 12 volts. U7 must operate on 12 volts to guarantee automatic reset on power-up. Another section of U19 converts the 12-volt output of U7 to TTL levels and drives the chip disable line on U6.

Relays K6 through K10 are used to interface the microwave status to the *Spectra–TAC* Signal Quality Modules.

3. FUNCTIONAL SPECIFICATIONS

3.1 INPUTS FROM *SPECTRA-TAC*

The inputs from *Spectra–TAC* are on edge connector pins 14, 19, 18, 15, and 17. These inputs are designed to read the status of the Fail line on *Spectra–TAC* or *Digi–TAC*.

The input is terminated with 47 kilohms to ground.

The input switching threshold is set to 6 volts +/- 5% by the resistive divider consisting of R39 and R45. There is an input hysteresis of 0.45 volts.

3.2 INPUTS FROM MICROWAVE M-LEADS

The inputs from the Microwave are on edge connector pins 27, 25, 63, 61, and 51. These inputs are designed to read the status of the M-lead on the Microwave. If the input is between ground and -24 volts, the TAC Disable output relay contacts will be Open.

The input is terminated with a 27-kilohm pull-up to +12 volts.

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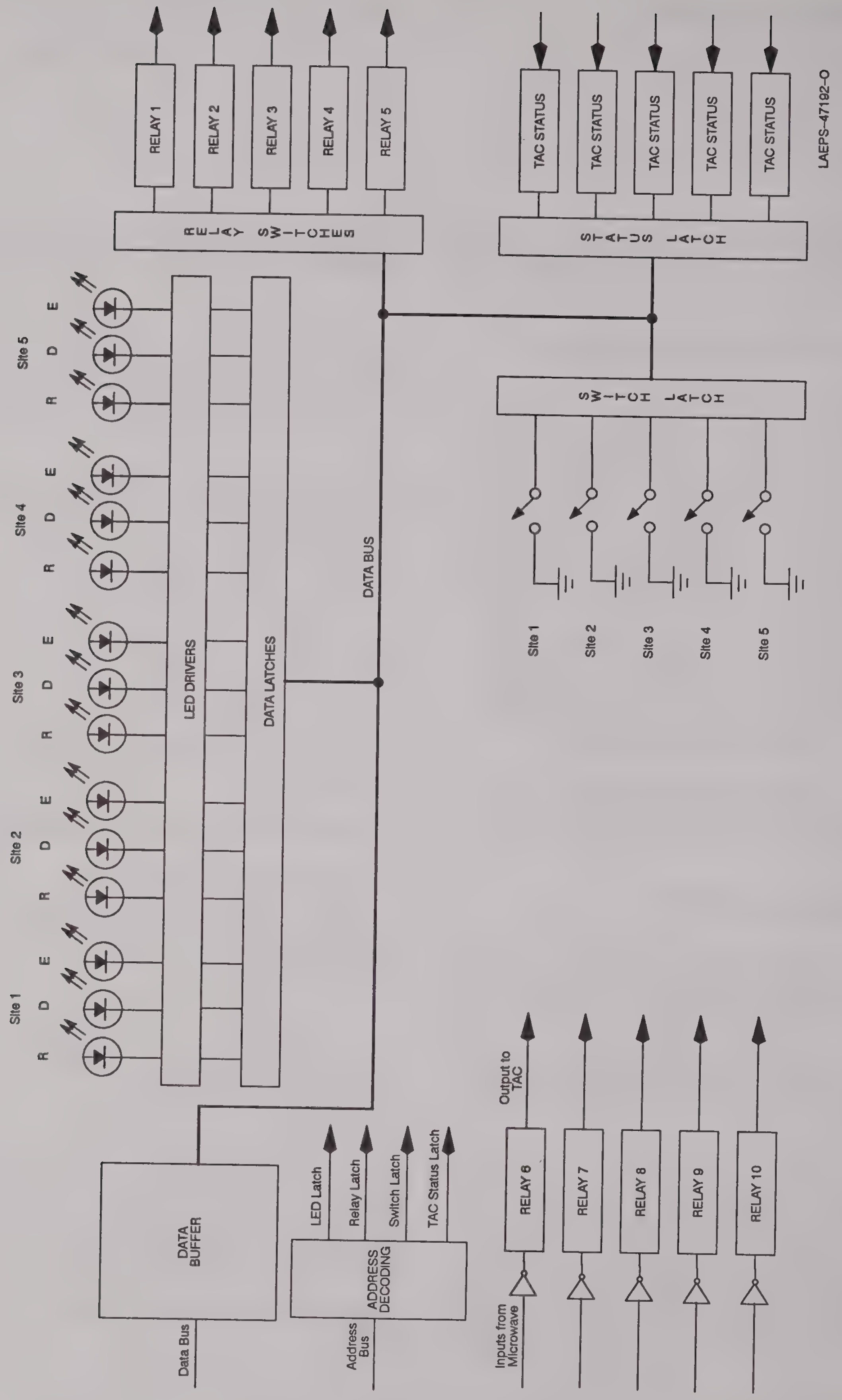

RELAY 1
RELAY 2
RELAY 3
RELAY 4
RELAY 5
RELAY SWITCHES
TAC STATUS
TAC STATUS
TAC STATUS
TAC STATUS
TAC STATUS
STATUS LATCH
LAEPS-47192-O
Site 1
Site 2
Site 3
Site 4
Site 5
R
D
E
LED DRIVERS
DATA LATCHES
DATA BUS
SWITCH LATCH
Site 1
Site 2
Site 3
Site 4
Site 5
DATA BUFFER
Data Bus
ADDRESS DECODING
Address Bus
LED Latch
Relay Latch
Switch Latch
TAC Status Latch
Output to TAC
RELAY 6
RELAY 7
RELAY 8
RELAY 9
RELAY 10
Inputs from Microwave

Figure 1. Site Interface Board Block Diagram

The input is designed to accept either –24 volts or ground as a valid input level.

3.3 OUTPUT TO TAC DISABLE

The outputs to TAC Disable are on edge connector pins 12, 48, 47, 13, and 46. These outputs are designed to activate the Disable line on the *Spectra–TAC* or *Digi–TAC*.

These outputs supply a relay contact closure to ground when the input from the microwave M–lead is not being pulled low.

The output relay contact is rated at 1 ampere at up to 28 volts dc.

3.4 OUTPUT TO MICROWAVE

The outputs to the Microwave are on edge connector pins 26, 30, 28, 24, 23, 20, 62, 64, 67, 60, 59, 56, 50, 52, and 55. These outputs are designed to supply –24 volts to the M–lead on the Microwave.

The outputs provide single–pole, double–throw, dry relay contacts controllable by the SAB.

The relay contacts are rated at 1 ampere at up to 28 volts dc.

3.5 FRONT PANEL SWITCHES

The front panel switches are pushbutton, locking–type switches. When a switch is locked in the depressed position, a logic high (+5V) is supplied to the appropriate data buffer.

3.6 DATA AND ADDRESS LINES

All other I/O lines (Data, Address, Lamp Test, and Reset) are LS–TTL compatible. (V_{ih} = 2.0 volts, minimum; V_{il} = 0.5 volt, maximum).

3.7 DISABLE TIMER

U7 is designed to disable the relay drivers for 15 seconds on power–up or after a reset.

Maximum time out = 19.5 seconds
Nominal time out = 16.9 seconds
Minimum time out = 14.3 seconds

3.8 POWER REQUIREMENTS

The power requirements for the SIB are as follows:

- +5.0 volts dc +/– 1.0 % @ less than 1.0 ampere.
- +12.0 volts dc +/– 1.0 % @ less than 1.0 ampere.

4. PINOUT TRANSLATION TO SITE INTERFACE CHASSIS

SIB interconnection with the Microwave and *Spectra–TAC* or *Digi–TAC* is via the Site Interconnect Chassis. Each SIB interfaces to Repeater connectors on the Site Interconnect Chassis.

- SIB number 1 has access to repeater connectors CH1 – CH7.
- SIB number 2 has access to repeater connectors CH8 – CH14.
- SIB number 3 has access to repeater connectors CH15 – CH21.

4.1 INTERCONNECTION TO MICROWAVE

Sites 1 through 5 correspond to Site Interconnect Chassis connectors CH1 through CH5.

The channel connectors on the Site Interconnect Chassis are 15–pin D connectors with pin functions as shown in Table 1.

Table 1. Channel Connectors CH1 Through CH5

Pin Number	Function
1	Not Used
2	Not Used
3	Not Used
4	Not Used
5	Not Used
6	Not Used
7	Input from M–lead
8	Ground
9	Not Used
10	Not Used
11	Not Used
12	Not Used
13	Normally CLOSED relay contact
14	COMMON relay Contact
15	Normally OPEN relay contact

4.2 SITE CONNECTION

The SIB edge connector pins used for input to and output from the Microwave (channels 1 through 5, associated with sites 1 through 5) are shown in Table 2. The pins in the M–Lead INPUT and GROUND columns are associated with inputs from the Microwave M–leads. The pins in the COMMON, NC, and NO columns are associated with outputs to the Microwave.

Table 2.SIB Edge Connector Pins – Channels 1 Through 5

CH	M–Lead INPUT	GROUND	COMMON	NC	NO
1	27	29	26	30	28
2	25	21	24	23	20
3	63	66	62	64	67
4	61	57	60	59	56
5	51	54	50	52	55

4.3 INTERCONNECTION TO *SPECTRA–TAC* OR *DIGI–TAC*

On the Site Interface Chassis, repeater connector CH6 is the Failed input from the TAC and repeater connector CH7 is the Disable output to the TAC. Both connectors have the pinout configuration shown in Table 3.

The SIB edge connector pins used to connect the various sites to Site Interconnect Chassis connectors CH6 and CH7 are shown in Table 4.

Table 3. Repeater Connectors CH6 and CH7

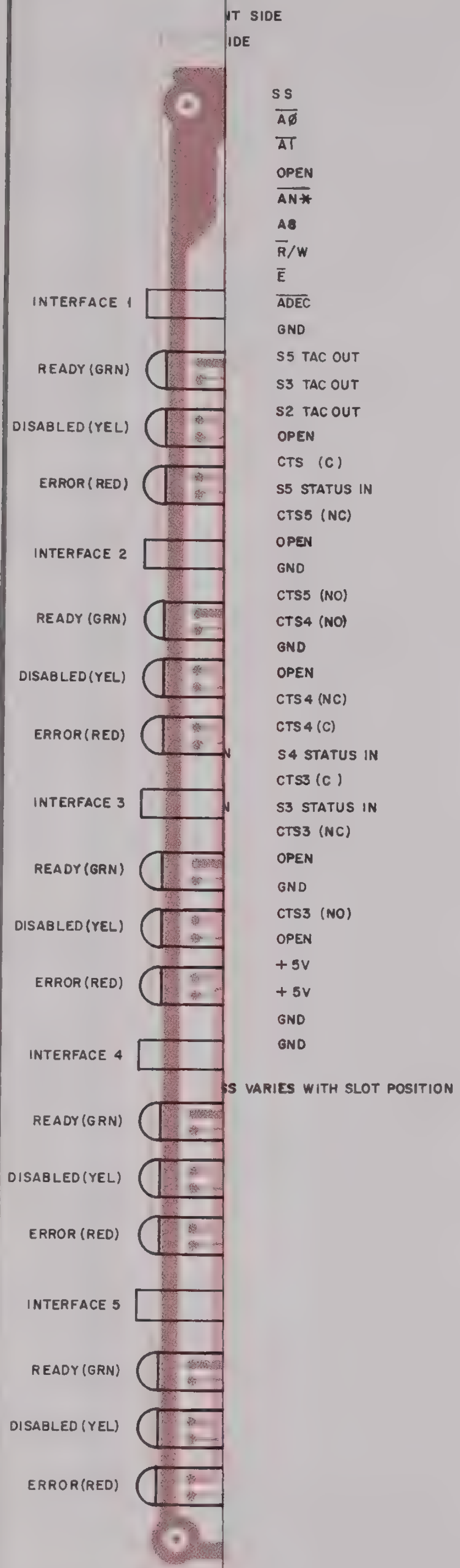
Pin Number	Function
1	Not Used
2	Not Used
3	Not Used
4	Not Used
5	Not Used
6	Site 5
7	Site 4
8	Site 3
9	Not Used
10	Not Used
11	Not Used
12	Not Used
13	Ground
14	Site 1
15	Site 2

Table 4. SIB Edge Connector Pins – Channels 6 and 7

SITE CONNECTOR	SITE 1	SITE 2	SITE 3	SITE 4	SITE 5	GND
CH6	14	19	18	15	17	16
CH7	12	48	47	13	46	45

TRN7124A SITE INTERFACE BOARD

CIRCUIT BOARD DETAIL, SCHEMATIC DIAGRAM, AND PARTS LIST


T SIDE
IDE
INTERFACE 1
READY (GRN)
DISABLED (YEL)
ERROR (RED)
INTERFACE 2
READY (GRN)
DISABLED (YEL)
ERROR (RED)
INTERFACE 3
READY (GRN)
DISABLED (YEL)
ERROR (RED)
INTERFACE 4
READY (GRN)
DISABLED (YEL)
ERROR (RED)
INTERFACE 5
READY (GRN)
DISABLED (YEL)
ERROR (RED)
SS
A0
A1
OPEN
AN*
A8
R/W
E
ADEC
GND
S5 TAC OUT
S3 TAC OUT
S2 TAC OUT
OPEN
CTS (C)
S5 STATUS IN
CTS5 (NC)
OPEN
GND
CTS5 (NO)
CTS4 (NO)
GND
OPEN
CTS4 (NC)
CTS4 (C)
S4 STATUS IN
CTS3 (C)
S3 STATUS IN
CTS3 (NC)
OPEN
GND
CTS3 (NO)
OPEN
+5V
+5V
GND
GND
S VARIES WITH SLOT POSITION

4.2 SITE CONNECTION

The SIB edge connector pins used for input to and output from the Microwave (channels 1 through 5, associated with sites 1 through 5) are shown in Table 2. The pins in the M–Lead INPUT and GROUND columns are associated with inputs from the Microwave M–leads. The pins in the COMMON, NC, and NO columns are associated with outputs to the Microwave.

Table 2.SIB Edge Connector Pins – Channels 1 Through 5

CH	M–Lead INPUT	GROUND	COMMON	NC	NO
1	27	29	26	30	28
2	25	21	24	23	20
3	63	66	62	64	67
4	61	57	60	59	56
5	51	54	50	52	55

4.3 INTERCONNECTION TO *SPECTRA–TAC* OR *DIGI–TAC*

On the Site Interface Chassis, repeater connector CH6 is the Failed input from the TAC and repeater connector CH7 is the Disable output to the TAC. Both connectors have the pinout configuration shown in Table 3.

The SIB edge connector pins used to connect the various sites to Site Interconnect Chassis connectors CH6 and CH7 are shown in Table 4.

Table 3. Repeater Connectors CH6 and CH7

Pin Number	Function
1	Not Used
2	Not Used
3	Not Used
4	Not Used
5	Not Used
6	Site 5
7	Site 4
8	Site 3
9	Not Used
10	Not Used
11	Not Used
12	Not Used
13	Ground
14	Site 1
15	Site 2

Table 4. SIB Edge Connector Pins – Channels 6 and 7

SITE CONNECTOR	SITE 1	SITE 2	SITE 3	SITE 4	SITE 5	GND
CH6	14	19	18	15	17	16
CH7	12	48	47	13	46	45

TRN7124A SITE INTERFACE BOARD

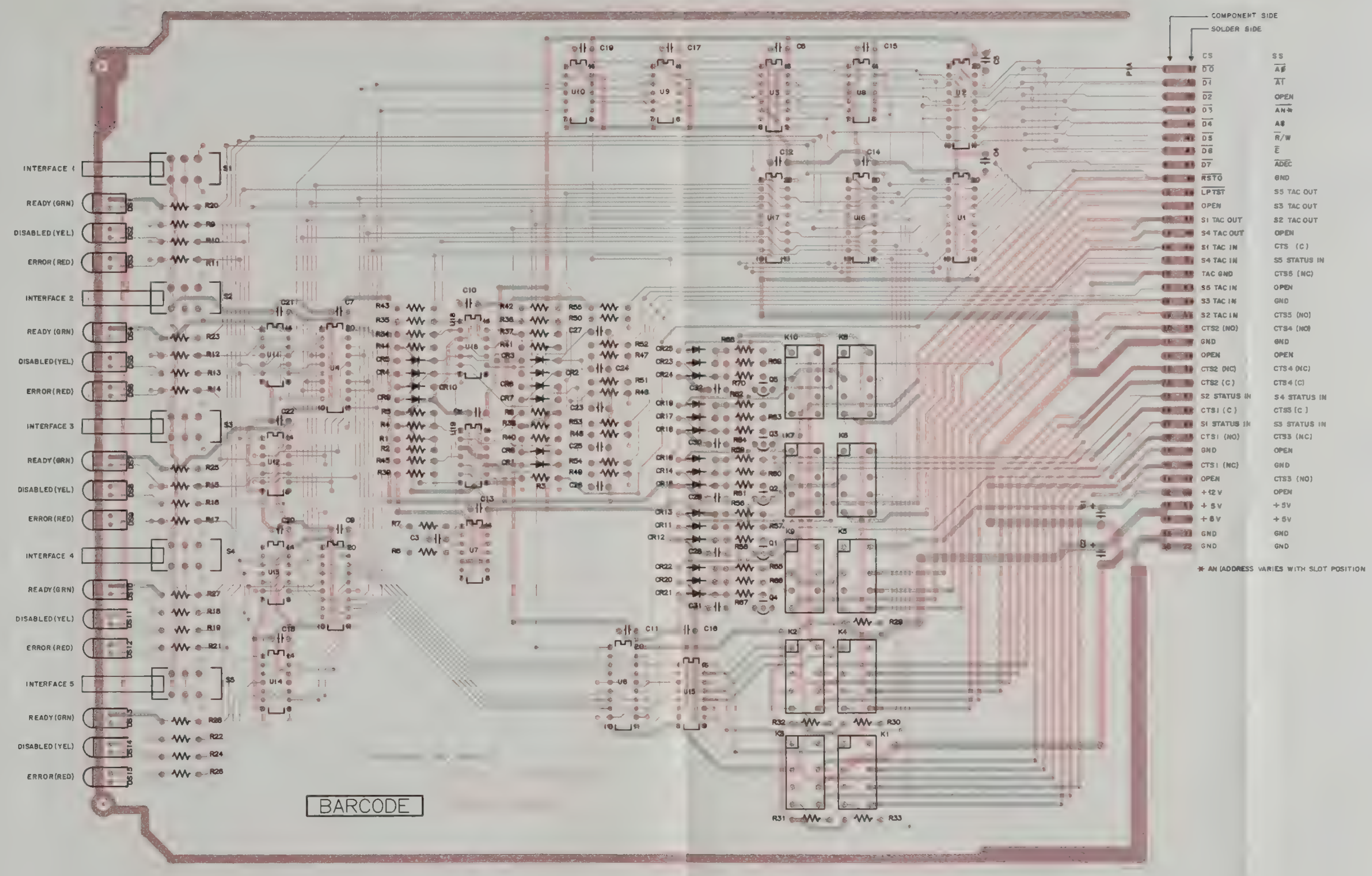
CIRCUIT BOARD DETAIL, SCHEMATIC DIAGRAM, AND PARTS LIST

parts list

TRN7124A Site Interface Board PL-11441-O

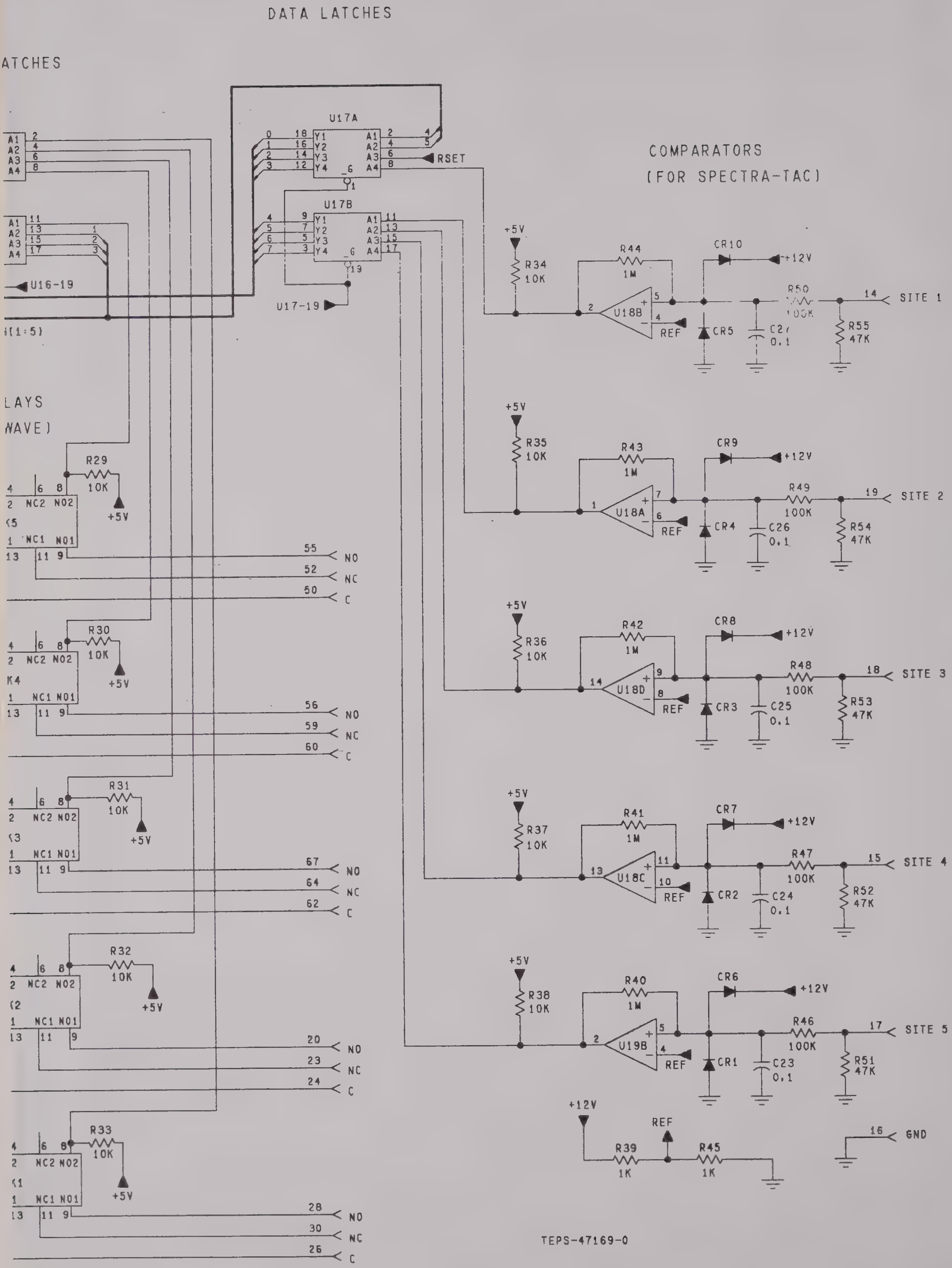
REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitor, fixed:
C1,2	2311019A46	100uF ±20% 25V
C3	0811051A04	.0033uF ±5% 63V
C4 thru 32	0811051A13	0.1uF ±5% 63V
		diode: (see note)
CR1 thru 12	4883654H01	silicon
CR13	4882466H18	silicon
CR14,15	4883654H01	silicon
CR16	4882466H18	silicon
CR17,18	4883654H01	silicon
CR19	4882466H18	silicon
CR20,21	4883654H01	silicon
CR22	4882466H18	silicon
CR23,24	4883654H01	silicon
CR25	4882466H18	silicon
		light emitting diode: (see note)
DS1	4888245C22	green
DS2	4888245C23	yellow
DS3	4888245C24	red
DS4	4888245C22	green
DS5	4888245C23	yellow
DS6	4888245C24	red
DS7	4888245C22	green
DS8	4888245C23	yellow
DS9	4888245C24	red
DS10	4888245C22	green
DS11	4888245C23	yellow
DS12	4888245C24	red
DS13	4888245C22	green
DS14	4888245C23	yellow
DS15	4888245C24	red
		relay:
K1 thru 10	8084090N03	2A 12Vdc
		transistor: (see note)
Q1 thru 5	4800869706	NPN type M9706
		resistor, fixed: ±5% 1/4W
R1	0611009A63	3.9k
R2	0611009A73	10k
R3	0611009A59	2.7k
R4	0611009B06	220k
R5	0611009A73	10k
R6	0611009B02	150k
R7	0611009A93	68k
R8	0611009A73	10k
R9 thru 19	0611009A39	390
R20	0611009A73	10k
R21,22	0611009A39	390
R23	0611009A73	10k
R24	0611009A39	390
R25	0611009A73	10k
R26	0611009A39	390
R27 thru 38	0611009A73	10k
R39	0611009A49	1k
R40 thru 44	0611009B22	1 meg
R45	0611009A49	1k
R46 thru 50	0611009A97	100k
R51 thru 55	0611009A89	47k
R56,57	0611009A83	27k
R58	0611009A49	1k
R59,60	0611009A83	27k
R61	0611009A49	1k
R62,63	0611009A83	27k
R64	0611009A49	1k
R65,66	0611009A83	27k
R67	0611009A49	1k
R68,69	0611009A83	27k
R70	0611009A49	1k
		switch:
S1 thru 5	4084324C17	dpdt pusbutton
		integrated circuit: (see note)
U1	5184810F34	inverted 3-state octal bus transceivers
U2	5184118K78	octal buffer w/3-state outputs
U3	5184118K34	3-line to 8-line decoder
U4 thru 6	5184118K90	octal D-type flip-flop w/3-state outputs
U7	5184887K83	programmable timer
U8	5184118K29	triple 3-input NAND gates
U9	5184118K05	hex inverters
U10	5184118K06	quad 2-input NAND gates
U11 thru 14	5184118K41	positive quad 2-input NOR buffer
U15	5183222M75	5V log-to-LED display interface
U16,17	5184118K78	octal buffer w/3-state outputs
U18,19	5184320A51	quad comparator
	non-referenced items	
	0300134184	SCREW, locking: 4-40 × 5/16; 2 used
	1484891E02	INSULATOR, standoff switch: 10 used for S1-5
	3884683F01	PUSHBUTTON: 5 used for S1-5
	4184891F01	SPRING
	4282506T01	RETAINER, ID
	5484553P01	LABEL, bar code
	5582239K01	LATCH
	6484680F17	PANEL, front

note: For optimum performance, diodes, transistors, and integrated circuits must be ordered by Motorola part numbers


INTERFACE 1
READY (GRN)
DISABLED (YEL)
ERROR (RED)
INTERFACE 2
READY (GRN)
DISABLED (YEL)
ERROR (RED)
INTERFACE 3
READY (GRN)
DISABLED (YEL)
ERROR (RED)
INTERFACE 4
READY (GRN)
DISABLED (YEL)
ERROR (RED)
INTERFACE 5
READY (GRN)
DISABLED (YEL)
ERROR (RED)
BARCODE
COMPONENT SIDE
SOLDER SIDE
CS
SS
D0 A0
D1 A1
D2 OPEN
D3 AN*
D4 A8
D5 R/W
D6 E
D7 ADEC
RSTO GND
LPTST S5 TAC OUT
OPEN S3 TAC OUT
S1 TAC OUT S2 TAC OUT
S4 TAC OUT OPEN
S1 TAC IN CTS (C)
S4 TAC IN S5 STATUS IN
TAC GND CTS5 (NC)
S6 TAC IN OPEN
S3 TAC IN GND
S2 TAC IN CTS5 (NO)
CTS2 (NO) CTS4 (NO)
GND GND
OPEN OPEN
CTS2 (NC) CTS4 (NC)
CTS2 (C) CTS4 (C)
S2 STATUS IN S4 STATUS IN
CTS1 (C) CTS3 (C)
S1 STATUS IN S3 STATUS IN
CTS1 (NO) CTS3 (NC)
GND OPEN
CTS1 (NC) GND
OPEN CTS3 (NO)
+12 V OPEN
+5 V +5V
+5 V +5V
GND GND
GND GND
* AN (ADDRESS VARIES WITH SLOT POSITION

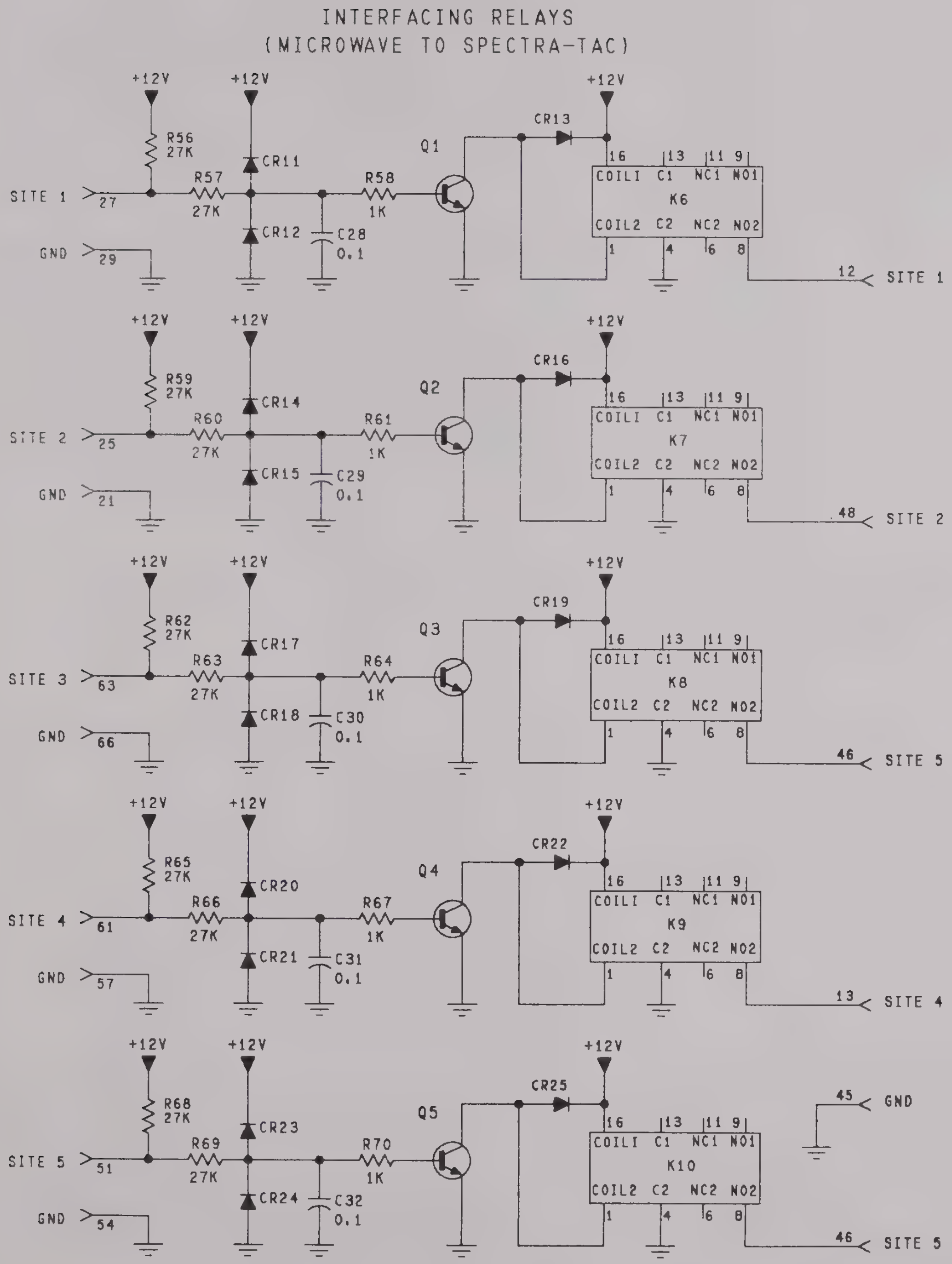
SHOWN FROM COMPONENT SIDE

COMPONENT SIDE = BD-DEPS-47802-O
SOLDER SIDE = BD-DEPS-47803-O
OL DEPS-47804-O


DATA LATCHES
ATCHES
U17A
U17B
RSET
U16-19
U17-19
LAYS
WAVE)
COMPARATORS
(FOR SPECTRA-TAC)
U18B
U18A
U18D
U18C
U19B
R29 10K
R30 10K
R31 10K
R32 10K
R33 10K
R34 10K
R35 10K
R36 10K
R37 10K
R38 10K
R44 1M
R43 1M
R42 1M
R41 1M
R40 1M
R50 100K
R49 100K
R48 100K
R47 100K
R46 100K
R55 47K
R54 47K
R53 47K
R52 47K
R51 47K
C27 0.1
C26 0.1
C25 0.1
C24 0.1
C23 0.1
CR10
CR9
CR8
CR7
CR6
CR5
CR4
CR3
CR2
CR1
R39 1K
R45 1K
REF
+5V
+12V
14 SITE 1
19 SITE 2
18 SITE 3
15 SITE 4
17 SITE 5
16 GND
55 NO
52 NC
50 C
56 NO
59 NC
60 C
67 NO
64 NC
62 C
20 NO
23 NC
24 C
28 NO
30 NC
26 C
K5
K4
K3
K2
K1
NC2 NO2
NC1 NO1
TEPS-47169-0

TRN7124A SITE INTERFACE BOARD

CIRCUIT BOARD DETAIL, SCHEMATIC DIAGRAM, AND PARTS LIST


INTERFACING RELAYS
(MICROWAVE TO SPECTRA-TAC)
+12V
R56 27K
R57 27K
CR11
CR12
R58 1K
C28 0.1
Q1
CR13
16 13 11 9
COIL1 C1 NC1 NO1
K6
COIL2 C2 NC2 NO2
1 4 6 8
SITE 1 27
GND 29
12 SITE 1
R59 27K
R60 27K
CR14
CR15
R61 1K
C29 0.1
Q2
CR16
K7
SITE 2 25
GND 21
48 SITE 2
R62 27K
R63 27K
CR17
CR18
R64 1K
C30 0.1
Q3
CR19
K8
SITE 3 63
GND 66
46 SITE 5
R65 27K
R66 27K
CR20
CR21
R67 1K
C31 0.1
Q4
CR22
K9
SITE 4 61
GND 57
13 SITE 4
R68 27K
R69 27K
CR23
CR24
R70 1K
C32 0.1
Q5
CR25
K10
SITE 5 51
GND 54
45 GND
46 SITE 5

P/O TEPS–47169–O

TRN7124A SITE INTERFACE BOARD

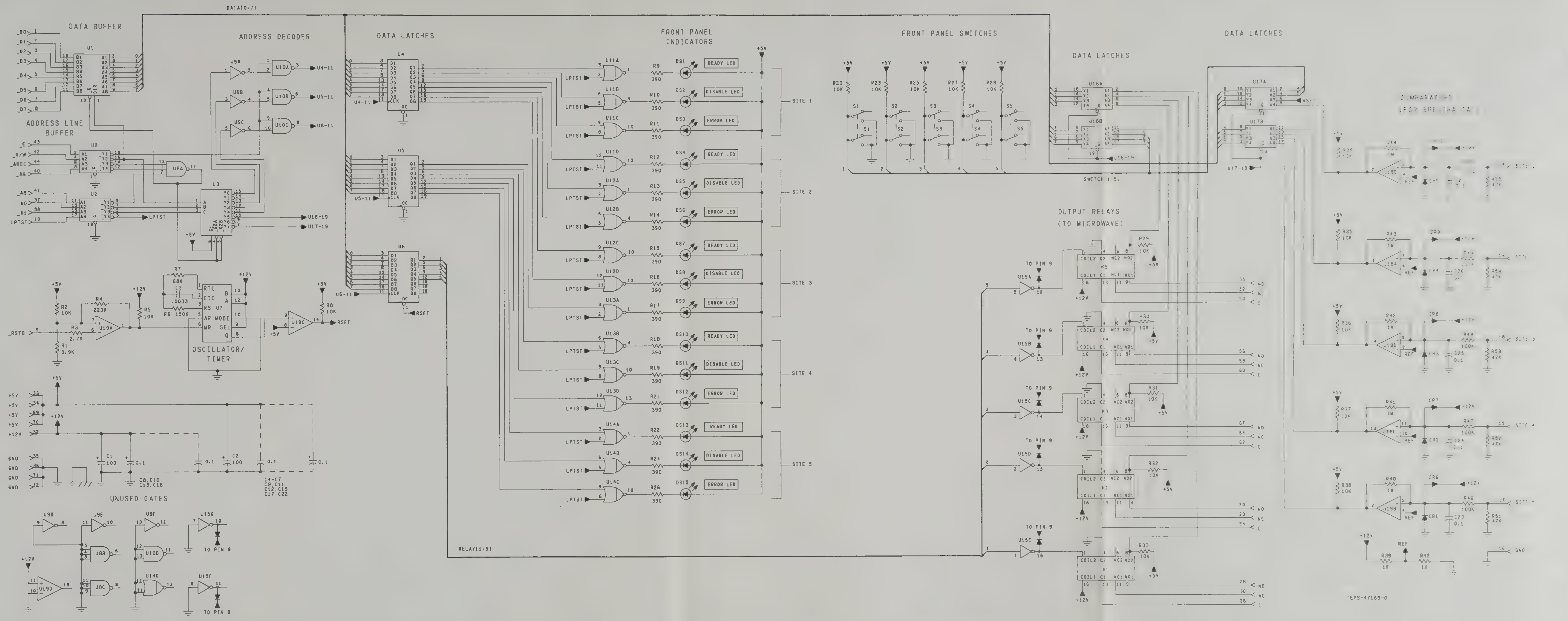
CIRCUIT BOARD DETAIL,
SCHEMATIC DIAGRAM,
AND PARTS LIST

NOTES:

1. UNLESS OTHERWISE SPECIFIED, ALL RESISTORS ARE IN OHMS AND ALL CAPACITORS ARE IN MICROFARADS.

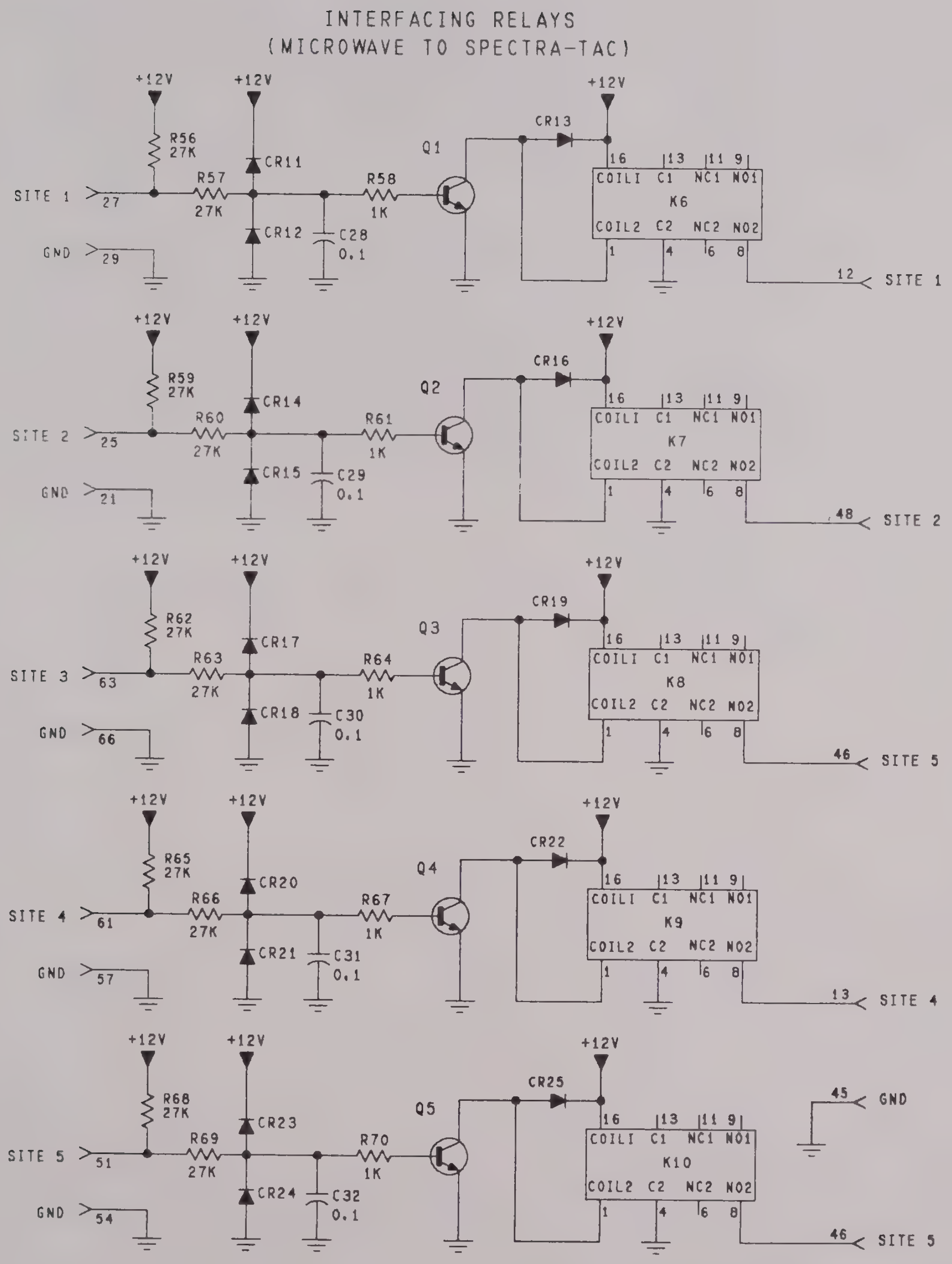
2. POWER CONNECTIONS FOR THE ICS ARE AS FOLLOWS

REF DESIG.	DESCRIPTION	+5V	GND	+12V
U1	INVERTED 3-STATE OCTAL BUS TRANSCEIVERS	20	10	
U2	OCTAL BUFFER W/3-STATE OUTPUTS	20	10	
U3	3-LINE TO 8-LINE DECODER	16	8	
U4 THRU U6	OCTAL D-TYPE FLIP-FLOP W/3-STATE OUTPUTS	20	10	
U7	PROGRAMMABLE TIMER		7	14
U8	TRIPLE 3-INPUT NAND GATES	14	7	
U9	HEX INVERTERS	14	7	
U10	QUAD 2-INPUT NAND GATES	14	7	
U11 THRU U14	QUAD 2-INPUT NOR BUFFER (OPEN COLLECTOR OUTPUTS)	14	7	
U15	PERIPHERAL DRIVER ARRAY		8	9
U16,U17	OCTAL BUFFER W/3-STATE OUTPUTS	20	10	
U18,U19	QUAD COMPARATOR		17	3


DATA(0:7)
DATA BUFFER
ADDRESS DECODER
DATA LATCHES
FRONT PANEL INDICATORS
FRONT PANEL SWITCHES
DATA LATCHES
DATA LATCHES
COMPARATOR (FOR SPECTRA-TAC)
ADDRESS LINE BUFFER
LPTST
U16-19
U17-19
RSET
OSCILLATOR/TIMER
_RSTO
READY LED
DISABLE LED
ERROR LED
SITE 1
SITE 2
SITE 3
SITE 4
SITE 5
SWITCH 1-5
OUTPUT RELAYS (TO MICROWAVE)
TO PIN 9
NO
NC
C
RELAY(1:5)
UNUSED GATES
REF
GND
EPS-47169-0

TRN7124A SITE INTERFACE BOARD

CIRCUIT BOARD DETAIL, SCHEMATIC DIAGRAM, AND PARTS LIST


INTERFACING RELAYS
(MICROWAVE TO SPECTRA-TAC)
+12V
R56 27K
R57 27K
CR11
CR12
C28 0.1
R58 1K
Q1
CR13
K6
COIL1 C1 NC1 NO1
COIL2 C2 NC2 NO2
16 13 11 9
1 4 6 8
SITE 1 27
GND 29
12 SITE 1
R59 27K
R60 27K
CR14
CR15
C29 0.1
R61 1K
Q2
CR16
K7
SITE 2 25
GND 21
48 SITE 2
R62 27K
R63 27K
CR17
CR18
C30 0.1
R64 1K
Q3
CR19
K8
SITE 3 63
GND 66
46 SITE 5
R65 27K
R66 27K
CR20
CR21
C31 0.1
R67 1K
Q4
CR22
K9
SITE 4 61
GND 57
13 SITE 4
R68 27K
R69 27K
CR23
CR24
C32 0.1
R70 1K
Q5
CR25
K10
SITE 5 51
GND 54
45 GND
46 SITE 5

P/O TEPS-47169-O

MOTOROLA INC.
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Sector

SITE AUDIO BOARD

MODEL TLN3099A

The SAB module consists of a microprocessor unit with enough support circuitry to interface with the Data Concentrator Board (DCB) and the Site Interface Board (SIB). The SAB is a standard Central Site Controller Board. It is the same as the TRN9968A Site Controller Board except for additional software and firmware (see Table 2). In addition, the SAB has a unique jumpering configuration, as shown in Table 1.

The SAB interfaces with the Site Interface Board (SIB) and the DCB to report audio path status of the remote sites and the microwave. The SAB continuously tests a microwave audio path and generates a diagnostic message if a malfunction occurs. When the audio path is back in service, the SAB generates a diagnostic message to report the updated status. For detailed information on the SAB, refer to the Site Controller Board section, 68P81066E61, of the Trunked Radio System Central Controller Instruction Manual, 68P81066E60.

NOTE

> The SAB module is used in *Smartnet II* AMSS only.

Table 1. SAB Jumper Usage

Jumper Ref.	Position	Jumper Ref.	Position
JU1	Out	JU13	300
JU2	Out	JU14	4800
JU3	Out	JU15	4800
JU4	A	JU16	Upper
JU5	B	JU17	A
JU6	B	JU18	Out
JU7	B	JU19	B
JU8	B	JU20	Upper
JU9	A	JU21	Out
JU10	A	JU22	In*
JU11	B	JU23	A
JU12	B		

*Remove jumper JU22 when inserting static or dynamic RAMs or removing them from circuit

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DESCRIPTION, INSTALLATION & MAINTENANCE

DESCRIPTION 68P81040E02
INSTALLATION 68P81066E58
SAFE HANDLING OF CMOS INTEGRATED CIRCUIT DEVICES 68P81106E84
MAINTENANCE 68P81040E04

CARD CAGE CHASSIS

21-CHANNEL CARD CAGE CHASSIS 68P81046E94

MODULES

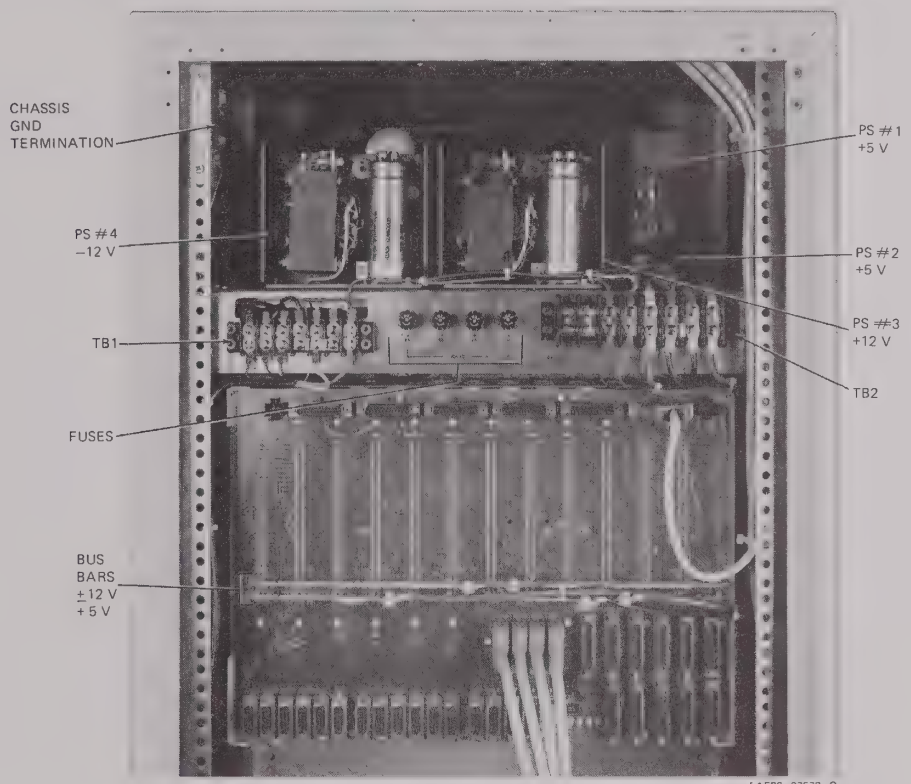
SITE CONTROLLER MODULES 68P81066E59
SITE CONTROLLER BOARD 68P81066E61
INBOUND RECOVER BOARD 68P81040E09
RECEIVER INTERFACE BOARD 68P81040E11
TRANSMITTER INTERFACE BOARD 68P81040E12
ASYNCHRONOUS COMMUNICATIONS BOARD 68P81125E55
SITE INTERFACE BOARD 68P81125E56
SITE AUDIO BOARD 68P81125E57

POWER SUPPLIES

POWER SUPPLIES 68P81040E13

MOTOROLA INC.
Communications
Sector

POWER SUPPLIES
MODELS TPN6114A
AND TPN6115A



FAEPS 27572-O
(S479)

Figure 1. Central Controller Power Supplies

1. POWER REQUIREMENTS

The central controller requires an input voltage of 97-145 volts ac at a current of 12 amperes, 50-60 Hz. The power supplies are shown in Figure 1. Model TPN6114A Power Supply is an Adtech Power Inc. Model APS5-25/S637 5 V Power Supply and Mounting Hardware. Model TPN6115A Power Supply is an Adtech Power Inc. Model APS12-4/S638 12 V Power Supply and Mounting Hardware. Refer to manufacturer supplied literature for servicing information.

2. POWER SUPPLY ADJUSTMENT

NOTE

All the following voltage measurements must be made at the cable connections on the bus bars on the central controller backplane.

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Step 1. Remove all modules from the central controller card cage.

Step 2. Turn on ac power (use S1 on the ac distribution box switch at the bottom rear of the central controller cabinet).

Step 3. Make the following coarse adjustments:

- adjust power supply #1 (+5 V) for +5.10 ±0.25 V
- adjust power supply #2 (+5 V) for +5.10 ±0.25 V
- adjust power supply #3 (+12 V) for +12.10 ±0.25 V
- adjust power supply #4 (-12 V) for -12.10 ±0.25 V

Step 4. Turn off ac power.

Step 5. Insert all modules into the card cage.

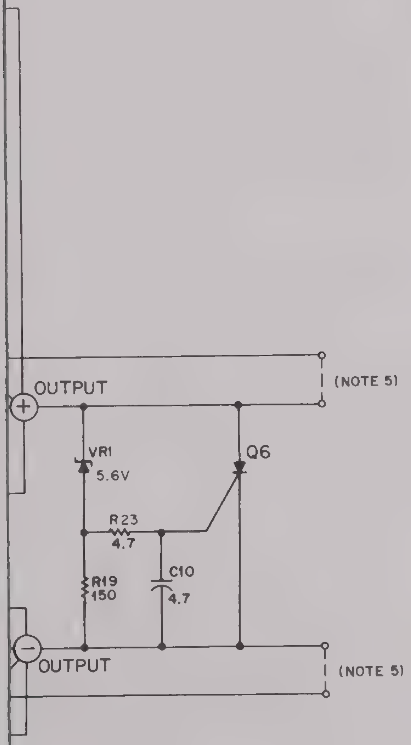
Step 6. Turn on ac power.

Step 7. Allow system to warm up for at least 10 minutes.

Step 8. Make the following fine adjustments:

- adjust power supply #1 (+5 V) for +5.15 ±0.10 V
- adjust power supply #2 (+5 V) for +5.15 ±0.10 V
- adjust power supply #3 (+12 V) for +12.10 ±0.10 V
- adjust power supply #4 (-12 V) for -12.10 ±0.10 V

TPN6114A 5 V POWER SUPPLY
SCHEMATIC DIAGRAM AND PARTS LIST


OUTPUT
+
(NOTE 5)
VR1
5.6V
Q6
R23
4.7
R19
150
C10
4.7
−
OUTPUT
(NOTE 5)

DEPS-26459-B

Step 1. Remove all modules from the central controller card cage.

Step 2. Turn on ac power (use S1 on the ac distribution box switch at the bottom rear of the central controller cabinet).

Step 3. Make the following coarse adjustments:

- adjust power supply #1 (+5 V) for +5.10 ±0.25 V
- adjust power supply #2 (+5 V) for +5.10 ±0.25 V
- adjust power supply #3 (+12 V) for +12.10 ±0.25 V
- adjust power supply #4 (-12 V) for -12.10 ±0.25 V

Step 4. Turn off ac power.

Step 5. Insert all modules into the card cage.

Step 6. Turn on ac power.

Step 7. Allow system to warm up for at least 10 minutes.

Step 8. Make the following fine adjustments:

- adjust power supply #1 (+5 V) for +5.15 ±0.10 V
- adjust power supply #2 (+5 V) for +5.15 ±0.10 V
- adjust power supply #3 (+12 V) for +12.10 ±0.10 V
- adjust power supply #4 (-12 V) for -12.10 ±0.10 V

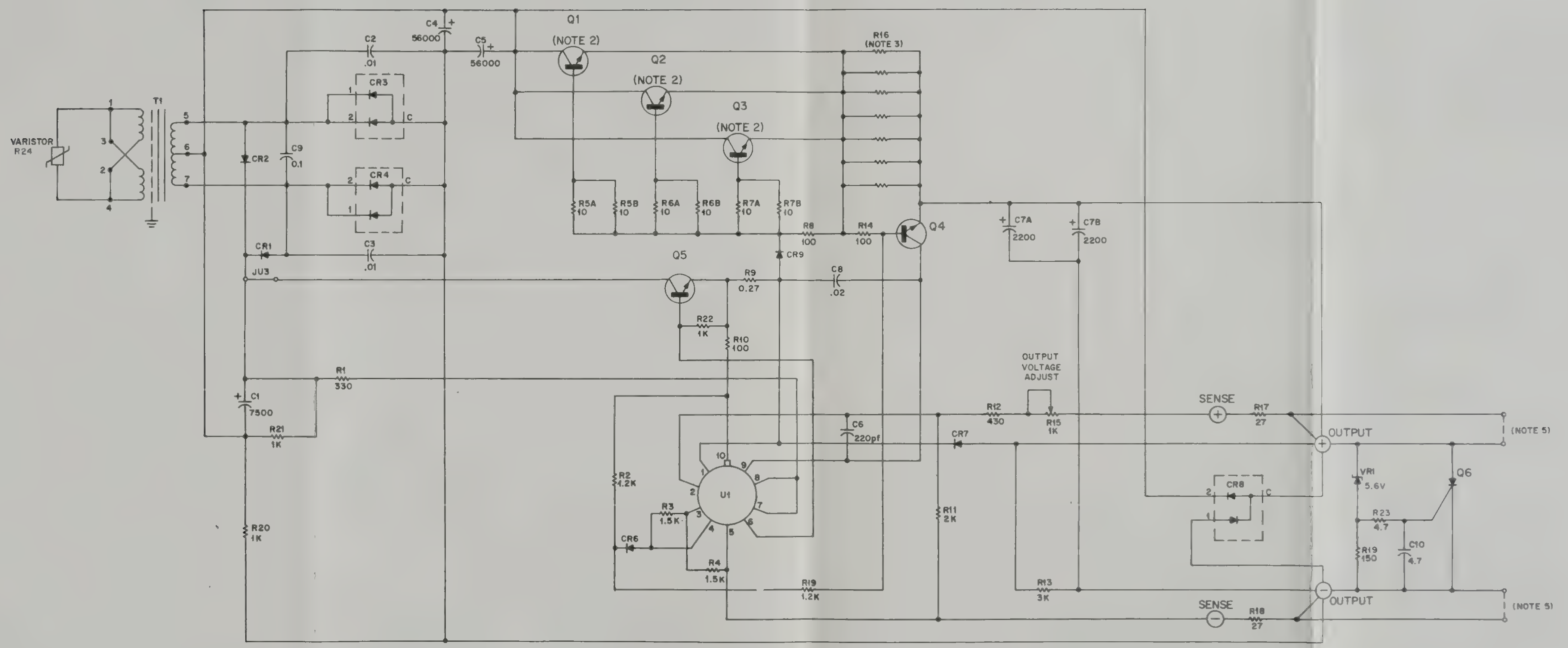
TPN6114A 5 V POWER SUPPLY
SCHEMATIC DIAGRAM AND PARTS LIST

parts list

TPN6114A 5 V Power Supply PL-7288-C

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitor, fixed: uF unless otherwise stated
C1	23-82486N23	7500 pF; 15 V
C2,3	21-82486N18	.01; 200 V
C4,5	23-82486N24	56,000; 15 V
C6	21-82486N17	220 pF
C7A,7B	23-82486N22	2200; 10 V
C8	21-82486N19	.02; 100 V
C9	21-82486N20	0.1; 100 V
C10	23-82486N21	4.7; 35 V
		diode: (see note)
CR1,2	48-82486N28	silicon
CR3,4	48-82846N29	silicon
CR5		NOT USED
CR6	48-82846N30	silicon
CR7	48-82846N31	silicon
CR8	48-82486N32	silicon
CR9	48-82486N28	silicon
		transistor: (see note)
Q1 thru 3	48-82486N25	NPN
Q4	48-82486N26	NPN
Q5	48-82486N27	NPN
Q6	48-82486N34	silicon controlled rectifier
		resistor, fixed: ±5%; 1/2 W: unless otherwise stated
R1	17-82486N08	330
R2	17-82486N11	1.2k ±1%
R3,4	17-82486N12	1.5k
R5A,5B	6-82486N04	10
R6A,6B	6-82486N04	10
R7A,7B	6-82486N04	10
R8	17-82486N06	100
R9	17-82486N02	0.27; 2 W
R10	17-82486N06	100
R11	17-82486N13	2k
R12	17-82486N09	430
R13	17-82486N14	3k
R14	17-82486N06	100
R15	18-82486N15	var. 1k; output voltage adjust
R16	17-82486N01	0.1; 5 W; 7 used
R17,18	17-82486N05	27
R19	17-82486N11	1.2k
R20 thru 22	17-82486N10	1k
R23	17-82486N03	4.7k
R24	48-82486N36	varistor; 150 V ac RMS type
		transformer:
T1	25-82486N16	power supply
		integrated circuit: (see note)
U1	51-82486N35	voltage regulator; type 723C
		voltage regulator: (see note)
VR1	48-82486N33	Zener; 5.6 V
		non-referenced items
	1-82565M01	ASSEMBLY, power supply; 5 V dc includes: all ref. items
	2-129892	NUT, hex; 8-32 x 5/16" x 1/8" x 5/32"; 4 used
	29-82008L02	LUG, ring tongue; 2 used
	29-847854	LUG, crimp terminal; 2 used
	300-812505	WIRE, battery; #8; RED; 18" used
	30-851875	WIRE, battery; #8; BLK; 18" used
	42-10217A02	TIE, strap; WHT; 3 used
	3-124074	SCREW, machine; 8-32 × 1/2"; 4 used
	4-84345A10	WASHER, 4 used

note: For optimum performance, diodes, transistors, and integrated circuits must be ordered by Motorola part numbers.


VARISTOR R24
T1
1
2
3
4
5
6
7
CR1
CR2
CR3
CR4
C2 .01
C3 .01
C9 0.1
C4 56000
C5 56000
JU3
Q1 (NOTE 2)
Q2 (NOTE 2)
Q3 (NOTE 2)
R16 (NOTE 3)
R5A 10
R5B 10
R6A 10
R6B 10
R7A 10
R7B 10
R8 100
R14 100
Q4
CR9
Q5
R9 0.27
C8 .02
C7A 2200
C7B 2200
R22 1K
R10 100
R1 330
C1 7500
R21 1K
R20 1K
R2 1.2K
R3 1.5K
R4 1.5K
CR6
U1
C6 220pf
CR7
R11 2K
R19 1.2K
OUTPUT VOLTAGE ADJUST
R12 430
R15 1K
R13 3K
SENSE
R17 27
R18 27
OUTPUT
(NOTE 5)
CR8
VR1 5.6V
Q6
R23 4.7
R19 150
C10 4.7

DEPS-26459-8

NOTES.

1. UNLESS OTHERWISE INDICATED:
RESISTOR VALUES ARE IN OHMS;
CAPACITOR VALUES ARE IN MICROFARADS
2. Q1, Q2, AND Q3 ARE SELECTED TRANSISTORS WITH BETA MATCHED TO +10% @ 5A
3. R16 CONSISTS OF SEVEN 0.1 OHM, 5–WATT, RESISTORS.
4. OUTPUT IS 5 V DC.
5. THE SAME POWER SUPPLY MODEL IS USED FOR EITHER +5 OR –5 VOLTS (WITH RESPECT TO GROUND). THE ONLY DIFFERENCE IS IN THE OUT AND SENSE CONNECTION. FOR +5 V OPERATION THE –OUT AND –SENSE ARE CONNECTED TO GROUND AND THE +OUT AND +SENSE ARE CONNECTED TO THE LOAD FOR –5 V OPERATION THESE CONNECTIONS ARE REVERSED.

AVAILABLE BACKGROUND REFERENCE PUBLICATIONS

Seven reference publications are available to provide background information needed to service some of the newer Motorola products more effectively. The information in these publications is not duplicated in our instruction manuals. To obtain your free copy, check the ones you want and return this self-mailer to us.

Check item desired:

☐	**Basic Logic Circuit Guide** Describes the basic logic circuits used in Motorola Communications digital equipment and the logic notational scheme used in our instruction manuals.	68P81105E88
☐	**"Digital Private-Line" Binary-Coded Squelch** Contains fundamentals of "Digital Private-Line" system operation, circuit operation and servicing techniques.	68P81106E83
☐	**Safe Handling of CMOS Integrated Circuit Devices** Describes special handling techniques needed to prevent irrepairable damage from static charges encountered with normal handling of CMOS devices.	68P81106E84
☐	**Reducing Noise Interference in Mobile Two-Way Radio Installations** Defines the major sources of noise encountered in a mobile radio installation and suggests methods of remedying them.	68P81109E33
☐	**Anti-Skid Braking Precautions** Provides installation suggestions and a detailed checkout procedure for installation of mobile radios in vehicles with anti-skid braking systems.	68P81109E34
☐	**Removal and Replacement of Chip Components on Circuit Boards** Contains general information and repair procedures relative to chip-type (leadless) components.	68P81113E77
☐	**Lightning Protection Recommendations** Provides general information concerning lightning protection for equipment sites. Also, provides a quick reference of available lightning protection kits.	68P81111E17

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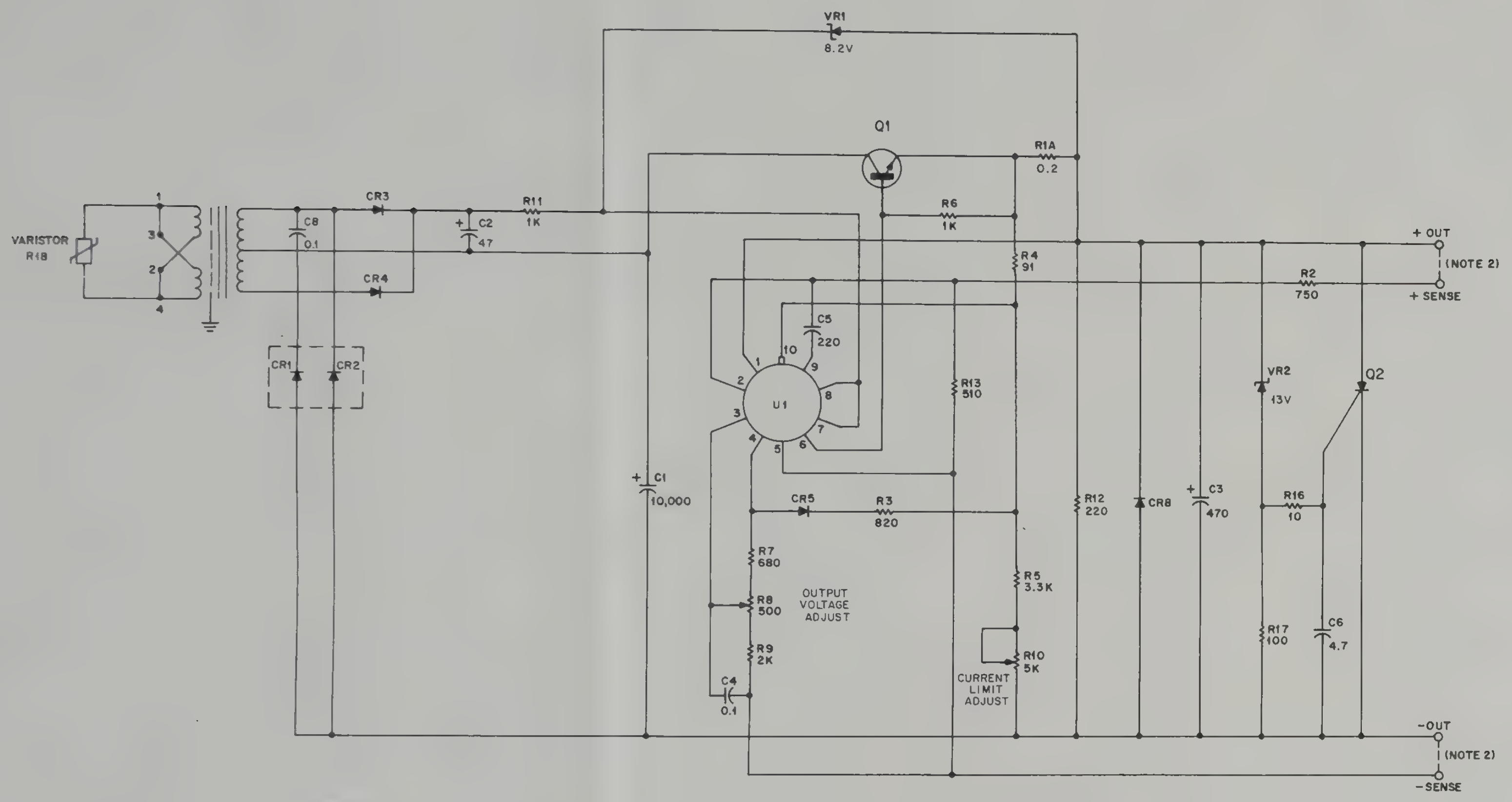
TPN6115A +12 V/-12 V POWER SUPPLY
SCHEMATIC DIAGRAM AND PARTS LIST


VR1
8.2V
Q1
R1A
0.2
VARISTOR
R18
1
3
2
4
CR3
C8
0.1
+
C2
47
R11
1K
R6
1K
R4
91
+ OUT
(NOTE 2)
R2
750
+ SENSE
CR4
C5
220
10
1
2
9
8
3
U1
7
4
5
6
CR1
CR2
R13
510
VR2
13V
Q2
+
C1
10,000
CR5
R3
820
R12
220
CR8
+
C3
470
R16
10
R7
680
R8
500
OUTPUT
VOLTAGE
ADJUST
R5
3.3K
R9
2K
R10
5K
R17
100
C6
4.7
C4
0.1
CURRENT
LIMIT
ADJUST
-OUT
(NOTE 2)
-SENSE
DEPS-26420-A

NOTES

1. UNLESS OTHERWISE INDICATED
RESISTOR VALUES ARE IN OHMS.
CAPACITOR VALUES ARE IN MICROFARADS

2. THE SAME POWER SUPPLY MODEL IS USED FOR EITHER +12 OR –12 VOLTS (WITH RESPECT TO GROUND). THE ONLY DIFFERENCE IS IN THE OUT AND SENSE CONNECTION FOR +12 V OPERATION THE –OUT AND –SENSE ARE CONNECTED TO GROUND AND THE +OUT AND +SENSE ARE CONNECTED TO THE LOAD FOR –12 V OPERATION THESE CONNECTIONS ARE REVERSED

parts list

TPN6115A 12 V Power Supply PL-7289-C

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitor, fixed: uF
C1	23-82487N22	10,000; 30 V
C2	23-82487N20	47; 50 V
C3	23-82487N21	470; 25 V
C4	21-82487N81	0.1; 100 V
C5	21-82486N17	220 pF
C6	23-82487N19	4.7; 35 V
C7		NOT USED
C8	21-82487N18	0.1; 100 V
		diode: (see note)
CR1,2	48-82487N25	silicon
CR3,4	48-82487N24	silicon
CR5	48-82487N26	silicon
CR6,7		NOT USED
CR8	48-82487N29	silicon
		transistor: (see note)
Q1	48-82487N23	NPN
Q2	48-82487N30	silicon controlled rectifier
		resistor, fixed: ±5%; 1/2 W: unless otherwise stated
R1A	6-82487N01	0.2
R2	17-82487N08	750
R3	17-82487N09	820
R4	17-82487N03	91
R5	17-82487N13	3.3k
R6	17-82487N10	1k
R7	17-82487N07	680
R8	18-82487N14	var. 500; output voltage adjust
R9	17-82487N12	2k
R10	18-82487N15	var. 5k; current limit adjust
R11	17-82487N11	1k; 2 W
R12	6-82487N05	220; 2 W
R13	17-82487N06	510
R14,15		NOT USED
R16	17-82487N02	10
R17	17-82487N04	100
R18	48-82486N36	varistor; 150 V ac RMS type
		integrated circuit: (see note)
U1	51-82487N31	voltage regulator; type 723C
		voltage regulator:
VR1	48-82487N28	Zener, 8.2 V
VR2	48-82487N27	Zener, 13 V
	non-referenced items	
	1-82566M01	ASSEMBLY, power supply; 12 V dc includes; all ref. items
	2-115123	NUT, hex: 10-32; 2 used
	2-10054A97	NUT, spring: 10-24; 2 used
	3-1940	SCREW, machine: 10-24 x 1/2"; 4 used
	4-7658	WASHER, lock: #10 internal; 4 used
	3-124074	SCREW, machine: 8-32 × 1/2"; 4 used
	4-84345A10	WASHER, 4 used

note: For optimum performance, diodes, transistors, and integrated circuits must be ordered by Motorola part numbers.

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Phone No. (include area code) ______________________________

*Whenever possible, give complete model number of equipment, and part number of diagram or part number of instruction section. **This information is important.**

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MOTOROLA INC.
Communications
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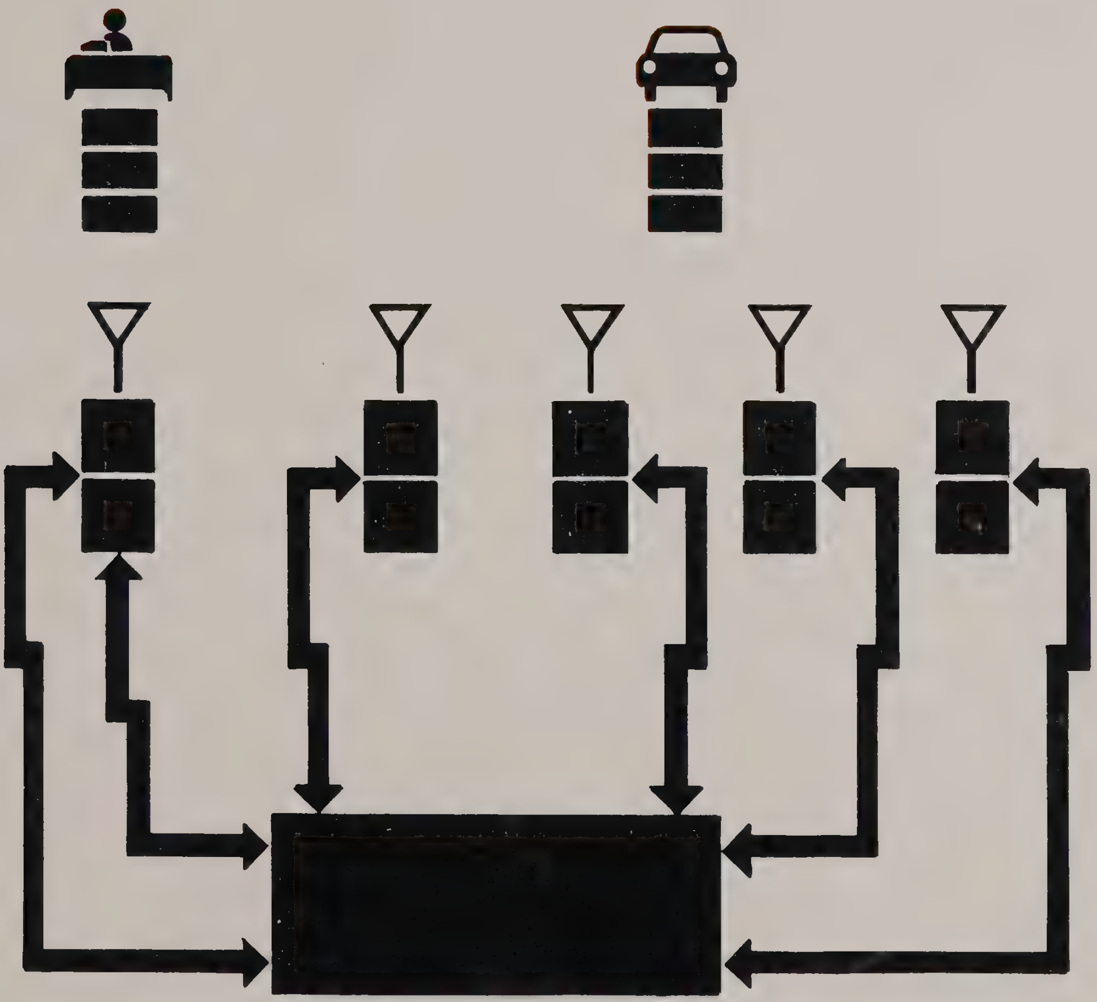
SYSTEM MANAGER OPERATING MANUAL

Trunked Radio Systems

Privacy Plus™/Sharenet™, Privacy Plus-Enhanced™,
Privacy Plus-SE™, SMARTNET II™, *Privacy Plus-Enhanced* with AMSS,
SMARTNET II+™, and SmartWorks™

CENTRAL CONTROLLERS



Instruction Manual

68P81079E75-B

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SYSTEM MANAGER OPERATING MANUAL TRUNKED RADIO SYSTEMS

Privacy Plus/Sharenet, *Privacy Plus–Enhanced*, *Privacy Plus–SE*,
SMARTNET II, *Privacy Plus–Enhanced* with AMSS,
SMARTNET II+ and *SmartWorks*
CENTRAL CONTROLLERS

CONTENTS

SECTION *NUMBER*

Commercial Warranty and Computer Software Copyrights .... inside cover
LIGHTNING PROTECTION RECOMMENDATIONS 68P81117E17

SYSTEM OVERVIEW

SYSTEM OVERVIEW 68P81081E86
1. General .... Page 1
2. Automatic System Identification .... Page 1
3. System Control Interface Program .... Page 1
   3.1 Introduction .... Page 1
   3.2 System Manager Capabilities .... Page 2
4. Hardware Requirements .... Page 2
   4.1 System Manager Terminal .... Page 2
   4.2 Null Modem Cabling .... Page 2
   4.3 Modems .... Page 2
   4.4 Other Peripheral Devices .... Page 5
5. Adjustments .... Page 5
6. General Operating Procedures .... Page 6
   6.1 User Notes .... Page 6
   6.2 Access to System Control Program .... Page 6
   6.3 Help System .... Page 9
   6.4 Timeout and Disconnect Control .... Page 9
   6.5 Command Input .... Page 9

COMMAND FUNCTIONS & RESPONSES

COMMAND FUNCTIONS AND RESPONSES 68P81081E87
1. Introduction .... Page 1
2. AFFILIATE Commands .... Page 2
   2.1 EDIT Command .... Page 2
   2.2 LIST Command .... Page 2
   2.3 CLEAR Command .... Page 2
   2.4 STATS Command .... Page 2
   2.5 QUIT Command .... Page 2
3. EXIT/BYE Command .... Page 4
4. CHAN Commands .... Page 4
   4.1 General .... Page 4
   4.2 Protecting/Unprotecting a Channel .... Page 5
   4.3 Shared User System Design .... Page 9

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COMMAND FUNCTIONS & RESPONSES (Cont'd.)

5. Date Command .... Page 10
6. DIAG Commands .... Page 10
   6.1 AUTOMATIC Command .... Page 10
   6.2 CLEAR Command .... Page 10
   6.3 MANUAL Command .... Page 10
   6.4 PRINT Command .... Page 10
   6.5 QUIT Command .... Page 10
7. PARM Command .... Page 13
8. PASSWORD Command .... Page 14
   8.1 General .... Page 14
   8.2 Command Messages .... Page 15
9. SAC (Subscriber Access Control) Commands .... Page 16
   9.1 User Records – *SMARTNET II* ID Scheme .... Page 16
   9.2 Command Summary .... Page 19
   9.3 OPTIONS Command .... Page 19
   9.4 ACTIVATE Command .... Page 19
   9.5 DEACTIVATE Command .... Page 20
   9.6 EDIT Command .... Page 20
   9.7 LIST Command .... Page 21
   9.8 STATS Command .... Page 23
   9.9 CLEAR Command .... Page 23
   9.10 SET Command .... Page 23
   9.11 CSAVE Command .... Page 23
   9.12 CLOAD Command .... Page 24
   9.13 QUIT Command .... Page 24
   9.14 Subscriber Record Error Detection/Correction .... Page 24
   9.15 SAC Error Messages .... Page 24
   9.16 SAC Operatioin on a *CoveragePLUS* System (Option D610) .... Page 25
   9.17 Using Subscriber Access Control .... Page 25
10. SERV Commands (Interconnect Shared Service Algorithms) .... Page 29
   10.1 General .... Page 29
   10.2 Summary of Commands .... Page 31
   10.3 LIST Command .... Page 31
   10.4 SET Command .... Page 31
   10.5 ENABLE Command .... Page 32
   10.6 DISABLE Command .... Page 32
   10.7 STATS Command .... Page 32
   10.8 SETD Command .... Page 33
   10.9 LIMITS Command .... Page 33
   10.10 QUIT Command .... Page 35
11. STAT Command .... Page 35
12. TEST Command .... Page 35
13. TIME Command .... Page 38
14. VER Command .... Page 38
15. EMRG Commands .... Page 39
   15.1 HELP Command .... Page 39
   15.2 TOP Command .... Page 40
   15.3 PREEMPT Command .... Page 40
   15.4 RESERVE nn Command .... Page 40
   15.5 HOLD MM:SS Command .... Page 40
   15.6 LIST Command .... Page 40
   15.7 MULY (Multi Group Emergency Call YES) Command .... Page 40
   15.8 MULN (Multi Group Emergency Call NO) Command .... Page 40
   15.9 QUIT Command .... Page 40
16. MGC Commands .... Page 40
   16.1 HELP Command .... Page 41

COMMAND FUNCTIONS & RESPONSES (Cont'd.)

16.2 INT Command .... Page 41
16.3 WAIT Command .... Page 41
16.4 STAT Command .... Page 41
16.5 QUIT Command .... Page 41
17. DVP (Digital Voice Privacy) Commands .... Page 41
17.1 HELP Command .... Page 42
17.2 INTERCONNECT Command .... Page 42
17.3 UPGRADE Command .... Page 42
17.4 LIST Command .... Page 42
17.5 QUIT Command .... Page 42
18. DATA Command .... Page 42
18.1 STATS Command .... Page 42
18.2 QUIT Command .... Page 43
19. SITE Commands .... Page 43
19.1 HELP Command .... Page 43
19.2 ENABLE and DISABLE Commands .... Page 44
19.3 CRITICAL and NON–CRITICAL Commands .... Page 44
19.4 INITIALIZE Command .... Page 44
19.5 STATUS Command .... Page 44

TELEPHONE INTERCONNECT COMMAND FUNCTIONS & RESPONSES

TELEPHONE INTERCONNECT COMMAND FUNCTIONS AND RESPONSES 68P81081E88
1. Introduction .... Page 1
2. AUTH Commands .... Page 1
2.1 ADD Command .... Page 2
2.2 TRAN Command .... Page 3
2.3 DELETE Command .... Page 7
2.4 EDIT Command .... Page 7
2.5 LIST Command .... Page 7
2.6 STATUS Command .... Page 7
2.7 PDIGIT Command .... Page 7
2.8 UPDATE Command .... Page 9
2.9 RESET Command .... Page 9
2.10 MSAVE Command .... Page 12
2.11 MLOAD Command .... Page 12
2.12 QUIT Command .... Page 12
3. BILL Commands .... Page 12
3.1 INIT Command .... Page 13
3.2 LAIR Command .... Page 19
3.3 LTEL Command .... Page 20
3.4 LEXC Command .... Page 21
3.5 MAIR Command .... Page 22
3.6 MTEL Command .... Page 22
3.7 MEXC Command .... Page 24
3.8 AEXC Command .... Page 24
3.9 DEXC Command .... Page 24
3.10 SAIR Command .... Page 24
3.11 STEL Command .... Page 30
3.12 CLNG and SLNG Commands .... Page 32
3.13 LOGY and LOGN Commands .... Page 34

TELEPHONE INTERCONNECT COMMAND FUNCTIONS & RESPONSES (Cont'd.)

3.14 PBXY and PBXN Commands .... Page 34
3.15 RSET Command .... Page 35
3.16 QUIT Command .... Page 36
3.17 GRDD Commands .... Page 36
4. TELL Commands .... Page 40

SYSTEM ALARMS

***SMARTNET II, Privacy Plus–Enhanced* & *SmartWorks* Models**

AUTOMATIC SYSTEM ALARM CAPABILITY 68P81081E89
(*SMARTNET II, Privacy Plus–Enhanced* & *SmartWorks* Models)
1. Introduction .... Page 1
2. System Manager's Terminal Alarm Messages .... Page 2
   2.1 General .... Page 2
   2.2 Message Examples .... Page 2
   2.3 Error Messages .... Page 2
   2.4 Diagnostic Message Glossary .... Page 10
3. Relay–Activated External Alarms .... Page 12

SYSTEM ALARMS

***SMARTNET II+* and *Privacy Plus–Enhanced* with AMSS Models**

AUTOMATIC SYSTEM ALARM CAPABILITY 68P81084E38
(*SMARTNET II+* and *Privacy Plus–Enhanced* with AMSS Models)
1. Introduction .... Page 1
2. System Manager's Terminal Alarm Messages .... Page 2
   2.1 General .... Page 2
   2.2 Message Examples .... Page 2
   2.3 Error Messages .... Page 2
   2.4 Diagnostic Message Glossary .... Page 10
3. Relay–Activated External Alarms .... Page 12

CONFIGURATIONS & THEORY OF OPERATION

TRUNKED SYSTEM CONFIGURATIONS 68P81081E92
1. Type I Systems .... Page 1
   1.1 Standard Fleet Configuration .... Page 1
   1.2 Optional Fleet Configurations .... Page 1
2. Type II Systems .... Page 2
3. Mixed Type I and Type II Systems .... Page 3
   3.1 General .... Page 3
   3.2 System Configuration .... Page 3

TRUNKED INTERCONNECT THEORY OF OPERATION 68P81081E93
1. Trunked Interconnect Billing .... Page 1
   1.1 General .... Page 1
   1.2 Airtime Billing .... Page 1
   1.3 TELCO Billing .... Page 2

CONFIGURATIONS & THEORY OF OPERATION (Cont'd.)

1.4 Miscellaneous Billing Facts and Figures .... Page 6

2. Trunked Interconnect Authorization .... Page 6

- 2.1 General .... Page 6
- 2.2 Authorization Parameters .... Page 7
- 2.3 Call Examples .... Page 9
- 2.4 Pre-Digit Processing .... Page 9
- 2.5 PBX Processing .... Page 10
- 2.6 Normal Digit Processing .... Page 11
- 2.7 Authorization List Notes .... Page 11

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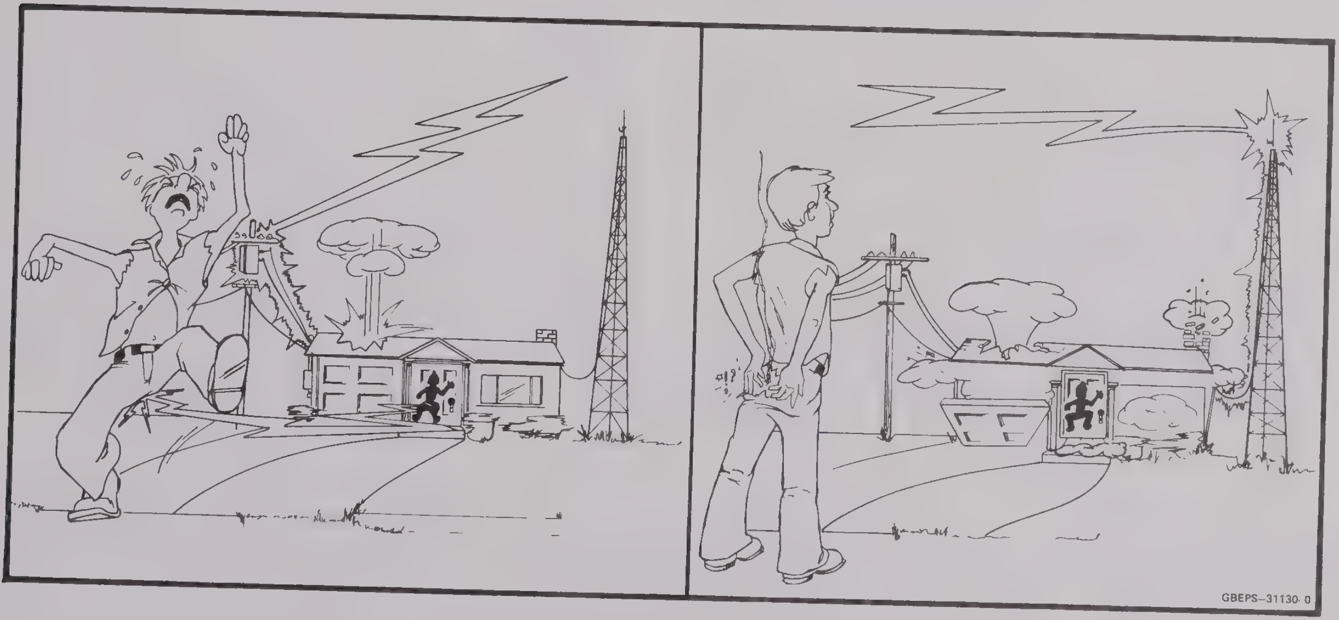
LIGHTNING PROTECTION RECOMMENDATIONS

The conditions that make a site desirable for two-way radio are the same as those that make a site an excellent target for lighting. Proper lightning protection can completely prevent equipment damage in all but the most severe strikes and even then keep the equipment damage at a minimum. Lightning protection basically consists of preventing the strike from entering the equipment room and then preventing damage to the equipment from induced voltages and currents on power and control lines to the equipment. The following suggestions will help protect valuable radio facilities. Some products already incorporate certain suppressors as standard equipment. In these cases, additional protection is not normally required, unless dictated by unique site considerations. When such unique situations occur, consult the appropriate area office for further information.

- Keep the tower grounding resistance as low as possible. The lightning stroke current belongs in the tower structure and grounding system, not on the transmission line.

- Use at least eight-foot long copper clad ground rods. Multiple ground rods are better than one, especially in dry climate or sandy-rocky soil areas.

- Bring the transmission line off the tower with the sharpest bend permitted by the manufacturer's specifications and make a solid bond between the tower and transmission line sheath just prior to the bend. The sharp bend acts as a spot impedance to the extremely high strike current. This shunts more of the strike current into the tower ground rather than into the equipment. Use no more or no less than the minimum bend radius wherever the transmission line changes direction and introduce a change of direction at every reasonable opportunity. Then, ground the transmission line sheath at the antenna side of each bend in the transmission line.



Unprotected power/control lines and antenna installations can be hazardous to equipment and personnel.

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- Provide additional grounding to the transmission line sheath wherever possible. Make it a point to ground the transmission line where it is supported on poles and where it enters a building.

- It is wise to take at least part of the transmission line through a length of grounded conduit.

- *Bond all equipment cabinets together to a single point*. Then, ground that point to a grounding rod network using as short and as straight a ground wire as possible. If bends in the ground wire are necessary, make them as large a radius as practical.

- Transmission lines should be brought into the equipment cabinets adjacent to the single point ground connection where a good low impedance bond can be made with the transmission line sheath.

- Install a gas tube protector between the equipment cabinet ground and AC-neutral where it enters the equipment cabinet. Install gas tube protectors where the control lines enter the building and at the point of entry into the equipment cabinet. Also, install gas tube protectors wherever control lines enter a building and install additional protectors as close to the remote control console as possible.

- Keep ground wires from gas tube protectors to ground rods or perimeter grounds as straight and short as possible. Avoid sharp bends in ground wires.

- Never bundle a ground wire with any other cabling or wiring. Also, never run a ground wire along any metal wall, along any electrical conduit, or inside a conduit.

Remember, the lower impedance the grounding system is in relation to the equipment being protected, the greater the protection afforded to the equipment. Keep the lightning strike current in the grounding network; not running through the equipment to ground.

RECOMMENDED PROTECTORS

The devices listed below are available from your local Motorola Parts Center. Other devices are available from different manufacturers for special applications and may be used in place of those listed herein. Installation instructions are generally packed with each device. The following listing contains phone line suppressors, ac line surge protectors, coaxial cable in-line lightning arrestors, and coaxial cable ground clamp kits. Refer to the Motorola Buyers Guide for additional information.

PHONE LINE SUPPRESSORS

TRN8187A	Single Line Suppressor, 3-electrode gas tube protector
TRN4589A	Dual Line Suppressor, 3-electrode gas tube protector
RRX4021B	Single Line Suppressor, 3-electrode gas tube protector

AC LINE SURGE PROTECTORS

TLN4399A	AC Line Surge Protector, 117 V ac line, 7/8” × 14 conduit hole mounting
TLN5920A	AC Line Surge Protector, 240 V ac line, 7/8” × 14 conduit hole mounting.

COAXIAL CABLE IN-LINE LIGHTNING ARRESTORS

RRX4024 UHF type connector
RRX4025 “N” type connector
RRX4032 Tower Mount Kit

COAXIAL CABLE GROUND CLAMP KITS

ST-788	For 1/2” jacketed heliax and pipe or grounding rod
ST-853	For 7/8” jacketed heliax and pipe or grounding rod
ST-789	For 1/2” unjacketed heliax, includes bushings for better contact without collapsing line
ST-790	For 7/8” unjacketed heliax, includes bushings for better contact without collapsing line

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SYSTEM OVERVIEW

1. GENERAL

This operating manual explains how the system manager terminal is used to communicate with an interactive computer program used by the Motorola Trunked Radio System. The program enables the system manager's terminal to perform various functions, such as: equipment and status alarm reporting; adjustment of the system timing parameters; channel activity status reporting; etc. The name of the interactive system control program is GUARDIAN (GRD).

Each command that can be entered via the system manager terminal is explained and typical examples are given. This operating manual shows how to interpret the various messages provided by the system. Also discussed are: the automatic system alarm capability; relay–activated external alarms; and the basic structure of the system, fleets and talk groups.

This manual covers the following models and options.

- T5177 *Privacy Plus–Enhanced/ShareNet* Central Controller
  - — Option D544 *SMARTNET* feature upgrade
- T5184 *SMARTNET II* Central Controller
  - — Option D163 Telephone Interconnect (4 channel)
  - — Option D401 Telephone Interconnect (9 channel)
  - — Option D436 Centralized Billing
- T5272 *SMARTNET II+* Central Controller
  - — Option D163 Telephone Interconnect (4 channel)
  - — Option D401 Telephone Interconnect (9 channel)
  - — Option D436 Centralized Billing
  - — Option D530 Simulcast Prime Site Upgrade
- T5291 *SMARTNET II+* AMSS Master Central Controller
- T5268 *Privacy Plus–Enhanced* with AMSS Master Central Controller
- T5188 Telephone Interconnect (4 channel)
  - — Option D401 Telephone Interconnect (9 channel)
- T5198 *SmartWorks* Central Controller
  - — Option D163 Telephone Interconnect (4 Channel)
  - — Option D436 Centralized Billing
  - — Option D565 System Wide/Fleetwide Call Control
  - — Option D566 Priority Monitor
  - — Option D429 Dynamic Regrouping
- T5199 900 MHz *Privacy Plus Enhanced/ShareNet* Central Controller
- T5255 *Privacy Plus Enhanced/ShareNet* Central Controller
  - — Option D163 Telephone Interconnect (4 Channel)
  - — Option D401 Telephone Interconnect (9 Channel)
  - — Option D436 Centralized Billing
  - — Option D544 *SMARTNET* feature upgrade
- T5320 *Privacy Plus–SE* Central Controller
  - — Same Options as T5255
  - — D610 *CoveragePLUS*

2. AUTOMATIC SYSTEM IDENTIFICATION

The Motorola Trunked Radio Systems comply with the automatic base station identification (BSI) rule set forth by the Federal Communications Commission (FCC). Consequently, the Motorola Trunked Radio System automatically transmits the FCC–assigned BSI characters on the lowest–available, active system channel every 30 minutes. International Morse Code is used for the transmission; BSI is transmitted at a speed of 17 words per minute.

If the lowest assigned system frequency is active with voice traffic at the time of identification transmission, the central controller delays the BSI transmission until traffic activity ceases on the lowest system frequency. Morse Code transmission of the BSI, on the lowest enabled system channel, then takes place.

If the trunked system's channels are covered under multiple licenses, e.g., a shared system, the central controller transmits a BSI for each license on the lowest frequency within the license. Up to 4 licenses can be supported, and BSIs and associated channels are programmed into the system code plug.

3. SYSTEM CONTROL INTERFACE PROGRAM

3.1 INTRODUCTION

The Motorola Trunked Radio System employs an interactive computer program that allows the system manager to use the system manager terminal to query the status of the trunked system base repeaters. In addition, it allows the system manager to enable or disable the base repeat-

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ers. The computer program also allows the system manager to modify, as desired, selected system operating characteristics.

Throughout this manual, 'interconnect models' are referred to indicate those items that apply only when the Models T5184, T5272, T5255 and T5320 were ordered with either options D163 or D401, or Model T5188 (with or without option D401) has been added. Option D163 and Model T5188 add telephone interconnect on 4 channels while Option D401 or Model T5188 with Option D401 add telephone interconnect on 9 channels.

The GUARDIAN program is accessed via an RS-232-C terminal connector provided **1)** for models equipped with the ICU (Interconnect Control Unit) option, on the backplane of the ICU, **2)** for *Privacy Plus-Enhanced*, *SMARTNET II*, or AMSS master site models not equipped with the ICU option, the backplane of the Central Controller, **3)** for *SmartWorks* central controllers, on the site interconnect chassis, or **4)** *SMARTNET II+* single site/simulcast prime sites not equipped with the ICU option, on the site interconnect chassis. Refer to Figure 1 or Figure 2 for the RS-232-C system manager terminal connector location.

The system manager terminal can be either locally attached at a distance of up to 50 cable feet (15.2 m), from the ICU/central controller or remotely linked, via dial-up or dedicated phone lines and modems.

3.2 SYSTEM MANAGER CAPABILITIES

3.2.1 Introduction

A system manager terminal provides the following functions:

- Equipment status and alarm reporting.
- Individual channel on/off capability.
- Adjustment of the system timing parameters.
- Channel activity status reporting.
- Date and time information entry for event testing.
- Entry of fleet to talk group affiliations.
- Adjustment of shared service algorithms.
- Interconnect activity status.

For interconnect models:

- Individual interconnect circuit on/off capability.
- Entry of individuals on the positive subscriber list to selectively enable access to interconnect.
- Entry of airtime and TELCO billing parameters.
- Airtime and TELCO charge reporting.
- Toll call records captured/displayed.

3.2.2 Data Format and Transmission

All communications between the trunked system central controller and the system manager terminal (or other peripheral equipment) employ unformatted strings of asynchronous ASCII characters. Each character frame comprises 10 bits having the following structure:

- A single start bit.
- An 8-bit information field.
- A single stop bit.

The 8-bit information field consists of a 7-bit ASCII character code and an eighth bit that is always zero. No parity bit is generated by the central controller, and any parity bit in accompanying transmissions from the terminal or other peripheral device is ignored. Refer to Figure 3 for the complete ASCII character set.

The system manager terminal/central controller communications link baud rate is selectable by a jumper located on the master controller board (MCB) for interconnect models and on the central site controller (CSC) for non-interconnect models. Any one of the following baud rates can be selected: 110, 300, 600, 1200, 1800, 2400, 3600, 4800 or 9600. Provisions for programming higher data rates are also contained on the MCB board. However, data rates in excess of 4800 baud should not be used for the system manager terminal.

4. HARDWARE REQUIREMENTS

4.1 SYSTEM MANAGER TERMINAL

There are many different terminals that can be used with the system manager port. Motorola offers the TDN7010 terminal. Other manufacturers supply dozens of others. In addition to these terminals, it is also possible to use a personal computer (PC) running a communications package or a terminal emulator package. All of these terminals or PCs must use the standard ASCII character set shown in Figure 3. In addition, the terminal device should have the following characteristics:

- Rate: up to 4800 baud (hard copy terminals are typically limited to 300 to 1200 baud).
- Communications: RS-232-C link.

4.2 NULL MODEM CABLING

If the terminal is connected directly to the trunked central controller via cable, a null modem cable is required with a maximum length of 50 feet (15.2 m). Refer to Figure 4 for construction details.

The terminal can be remotely linked to the central controller via telephone lines and modems. In this configuration, a standard RS-232-C cable connects the trunked central controller to the modem at the site. This cable is not a null modem cable. A standard RS-232-C cable can be purchased at a local computer supply store.

4.3 MODEMS

Modems used to remotely link the terminal to the trunked central controller should have the following characteristics:

- Rate: up to 4800 baud (consistent with baud rate of terminal) – typically limited to1200 baud for hard copy equipment.

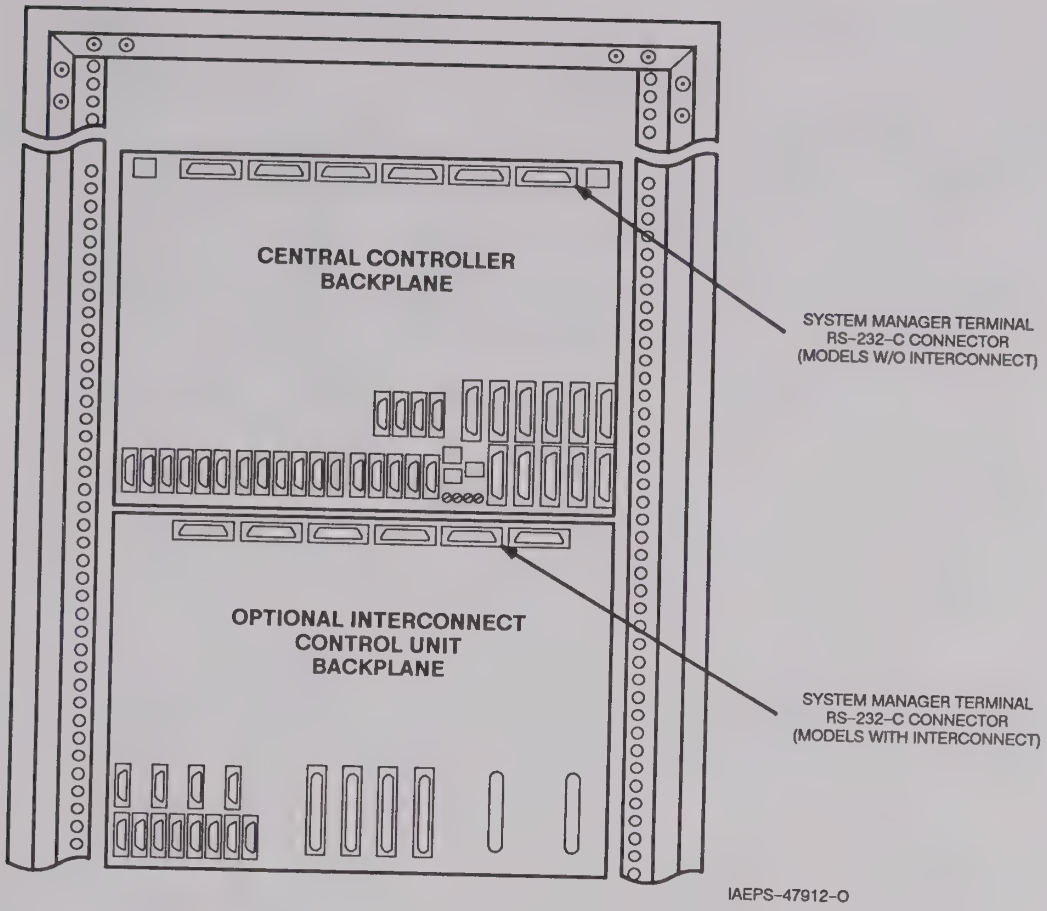
CENTRAL CONTROLLER BACKPLANE
SYSTEM MANAGER TERMINAL RS-232-C CONNECTOR (MODELS W/O INTERCONNECT)
OPTIONAL INTERCONNECT CONTROL UNIT BACKPLANE
SYSTEM MANAGER TERMINAL RS-232-C CONNECTOR (MODELS WITH INTERCONNECT)
IAEPS-47912-O

Figure 1. Connector Locations for 21-Channel and ICU Backplanes

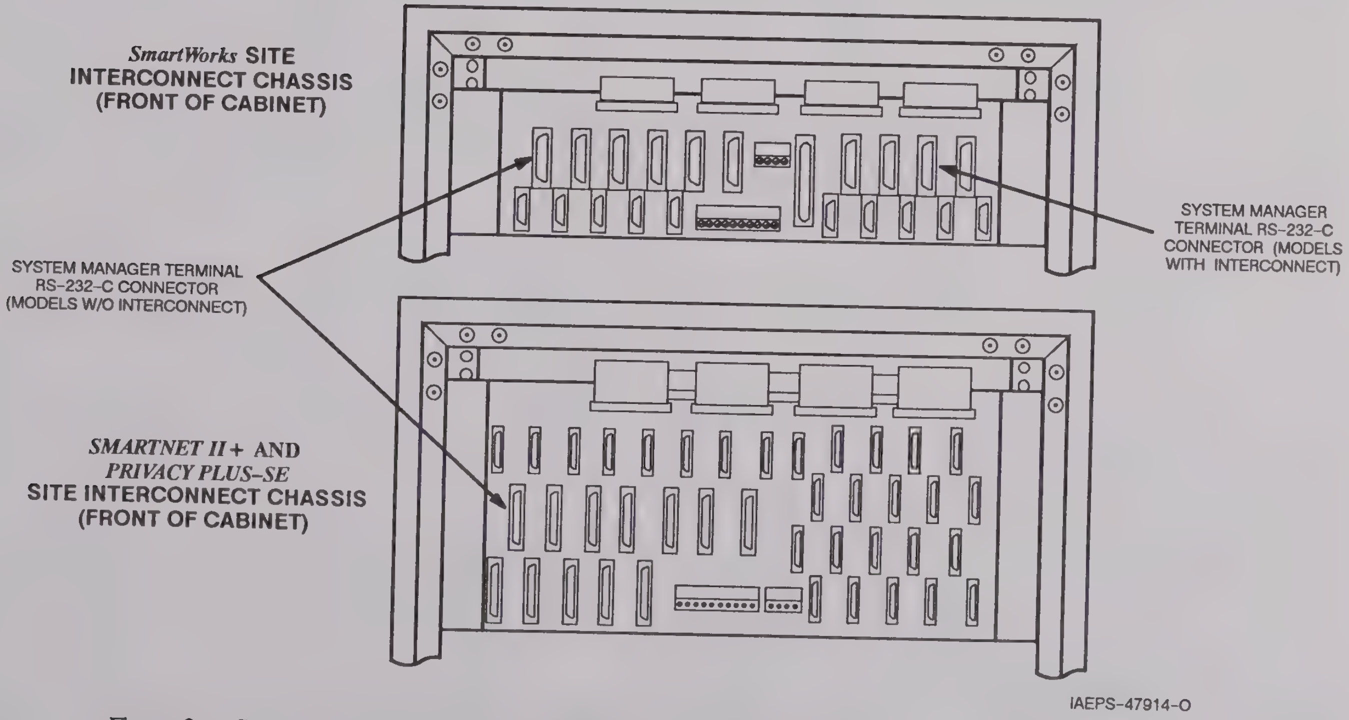
SmartWorks SITE INTERCONNECT CHASSIS (FRONT OF CABINET)
SYSTEM MANAGER TERMINAL RS-232-C CONNECTOR (MODELS WITH INTERCONNECT)
SYSTEM MANAGER TERMINAL RS-232-C CONNECTOR (MODELS W/O INTERCONNECT)
SMARTNET II+ AND *PRIVACY PLUS-SE* SITE INTERCONNECT CHASSIS (FRONT OF CABINET)
IAEPS-47914-O

Figure 2. Connector Locations for ***SmartWorks, SMARTNET II+*** *and* ***Privacy Plus-SE*** *Models*

B7	0	0	0	0	1	1	1	1
B6	0	0	1	1	0	0	1	1
B5	0	1	0	1	0	1	0	1
BITS B4 B3 B2 B1	CONTROL		NUMBERS SYMBOLS		UPPER CASE		LOWER CASE	
0 0 0 0	0 NUL 0 0	20 DLE 10 16	40 SP 20 32	60 0 30 48	100 @ 40 64	120 P 50 80	140 ‘ 60 96	160 p 70 112
0 0 0 1	1 SOH 1 1	21 DC1 11 17	41 ! 21 33	61 1 31 49	101 A 41 65	121 Q 51 81	141 a 61 97	161 q 71 113
0 0 1 0	2 STX 2 2	22 DC2 12 18	42 ” 22 34	62 2 32 50	102 B 42 66	122 R 52 82	142 b 62 98	162 r 72 114
0 0 1 1	3 ETX 3 3	23 DC3 13 19	43 # 23 35	63 3 33 51	103 C 43 67	123 S 53 83	143 c 63 99	163 s 73 115
0 1 0 0	4 EOT 4 4	24 DC4 14 20	44 $ 24 36	64 4 34 52	104 D 44 68	124 T 54 84	144 d 64 100	164 t 74 116
0 1 0 1	5 ENQ 5 5	25 NAK 15 21	45 % 25 37	65 5 35 53	105 E 45 69	125 U 55 85	145 e 65 101	165 u 75 117
0 1 1 0	6 ACK 6 6	26 SYN 16 22	46 & 26 38	66 6 36 54	106 F 46 70	126 V 56 86	146 f 66 102	166 v 76 118
0 1 1 1	7 BEL 7 7	27 ETB 17 23	47 ’ 27 39	67 7 37 55	107 G 47 71	127 W 57 87	147 g 67 103	167 w 77 119
1 0 0 0	10 BS 8 8	30 CAN 18 24	50 (28 40	70 8 38 56	110 H 48 72	130 X 58 88	150 h 68 104	170 x 78 120
1 0 0 1	11 HT 9 9	31 EM 19 25	51) 29 41	71 9 39 57	111 I 49 73	131 Y 59 89	151 i 69 105	171 y 79 121
1 0 1 0	12 LF A 10	32 SUB 1A 26	52 * 2A 42	72 : 3A 58	112 J 4A 74	132 Z 5A 90	152 j 6A 106	172 z 7A 122
1 0 1 1	13 VT B 11	33 ESC 1B 27	53 + 2B 43	73 ; 3B 59	113 K 4B 75	133 [5B 91	153 k 6B 107	173 { 7B 123
1 1 0 0	14 FF C 12	34 FS 1C 28	54 , 2C 44	74 < 3C 60	114 L 4C 76	134 \ 5C 92	154 l 6C 108	174 | 7C 124
1 1 0 1	15 CR D 13	35 GS 1D 29	55 - 2D 45	75 = 3D 61	115 M 4D 77	135] 5D 93	155 m 6D 109	175 } 7D 125
1 1 1 0	16 SO E 14	36 RS 1E 30	56 . 2E 46	76 > 3E 62	116 N 4E 78	136 ^ 5E 94	156 n 6E 110	176 ~ 7E 126
1 1 1 1	17 SI F 15	37 US 1F 31	57 / 2F 47	77 ? 3F 63	117 O 4F 79	137 _ 5F 95	157 o 6F 111	177 DEL (RUBOUT) 7F 127

LEGEND:

octal	25 NAK 15 21	ASCII character
hex		decimal

NUL : NULL
SOH : START OF HEADING
STX : START OF TEXT
ETX : END OF TEXT
EOT : END OF TRANSMISSION
ENQ : ENQUIRY
ACK : ACKNOWLEDGE
BEL : BELL
BS : BACKSPACE
HT : HORIZONTAL TABULATION
LF : LINE FEED
VT : VERTICAL TABULATION
FF : FORM FEED
CR : CARRIAGE RETURN
SO : SHIFT OUT
SI : SHIFT IN
DLE : DATA LINK ESCAPE
DC : DEVICE CONTROL
NAK : NEGATIVE ACKNOWLEDGE
SYN : SYNCHRONOUS IDLE
ETB : END OF TRANSMISSION BLOCK
CAN : CANCEL
EM : END OF MEDIUM
SUB : SUBSTITUTE
ESC : ESCAPE
FD : FILE SEPARATOR
GS : GROUP SEPARATOR
RS : RECORD SEPARATOR
US : UNIT SEPARATOR
SP : SPACE (BLANK)
DEL : DELETE

LAEPS–47860–O

Figure 3. ASCII Character Set

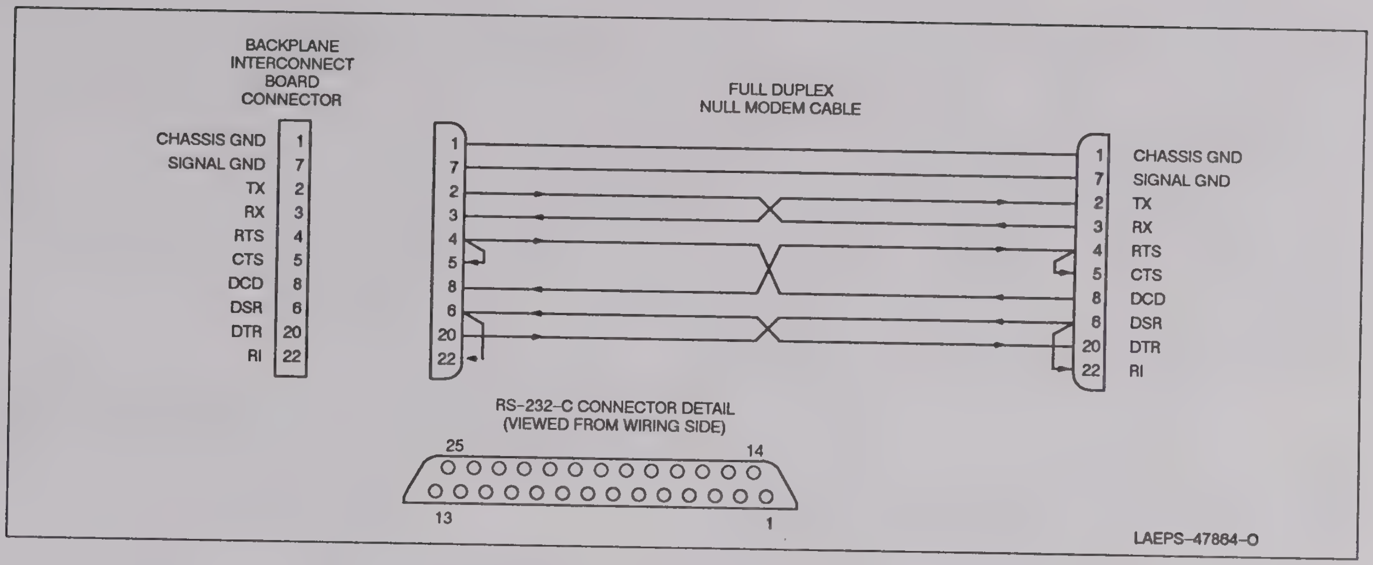
BACKPLANE INTERCONNECT BOARD CONNECTOR
FULL DUPLEX NULL MODEM CABLE
CHASSIS GND 1
SIGNAL GND 7
TX 2
RX 3
RTS 4
CTS 5
DCD 8
DSR 6
DTR 20
RI 22
RS-232-C CONNECTOR DETAIL (VIEWED FROM WIRING SIDE)
25
14
13
1
LAEPS-47864-O

Figure 4. Null Modem Cable

- Modulation : frequency–shift keying (FSK)
- Communications: asynchronous, duplex.
- Line interface: two–wire (dedicated or dial up).
- Terminal interface: RS–232–C.

NOTE

Bell System Model 103A Modem meets the 300 baud requirements. This modem or equivalent can be used.

Modems should be carefully selected to insure their compatibility with the equipment to which they are interfaced. The basic requirement is that the modems must provide for asynchronous, full duplex communications between the trunked system central controller and the system manager terminal or other peripheral device. The modem baud rate must also be carefully selected to satisfy the intended application.

For low–speed asynchronous data communications (1200 baud or less), straightforward FSK modulation techniques are used, and full duplex communications can occur on a leased two–wire telephone company circuit. These low–speed modems generally operate over unconditioned, voice grade lines. However, the grade of telephone line conditioning requirements must conform to the specifications set by the modem manufacturer.

Modems that operate at higher data rates are more expensive. Moreover, they may require the use of improved grade lines. Full duplex operation requirements can be satisfied only by leasing a 4–wire telephone company circuit.

Modems operating at baud rates of 1800 usually employ more sophisticated modulation schemes and operate in an asynchronous mode. Consequently, some form of synchronous–to–asynchronous conversion device would be required. Again, 4–wire conditioned telephone company lines should be used.

When the lines are leased from a telephone company that provides a data communication service, it is strongly recommended that the modems (or data sets) also be leased from the carrier. This arrangement may reduce any problems that could arise between the telephone company and the user, should the data communication link (modems and leased lines) fail to operate in a satisfactory manner.

4.4 OTHER PERIPHERAL DEVICES

In most applications, the peripheral device connected to the system manager terminal interface consists of a keyboard terminal with either hard–copy capability or CRT display.

5. ADJUSTMENTS

The optional system manager terminal is connected to the CSC RS–232–C connector on the central site controller site interconnect chassis/backplane at sites without an Interconnect Control Unit (ICU) (or is remotely linked via modems). The terminal/modem is connected to the J5 connecter on the ICU backplane at sites with an ICU.

Note the terminal baud rate and verify that the modem (if used) is compatible. Refer to Figure 5 and check that the jumper–selection on the CSC board in the central controller card cage (or on the MCB in the ICU card cage) is correct.

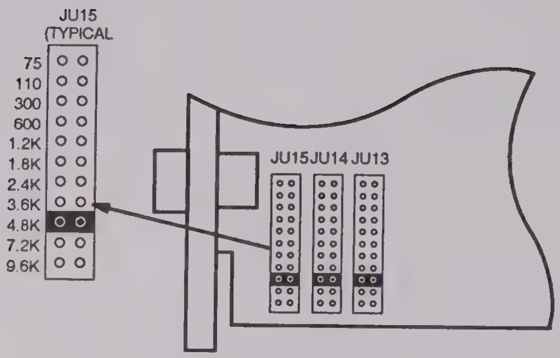

Figure 5. Baud Rate Jumpers

Step 1a. At sites **without** the ICU, turn off the central controller card cage power and remove the CSC module from the card cage.

Step 1b. At sites **with** the ICU, turn off the ICU card cage power and remove the MCB module from the card cage.

Step 2a. At sites **without** the ICU, locate jumper **JU15** in the lower left corner of the CSC board. Reposition the jumper if required.

Step 2b. At sites **with** the ICU, locate jumper **JU13** in the lower left corner of the MCB board. Reposition the jumper if required.

Step 3. Reinstall the CSC/MCB in its slot and re–apply power to the cardcage.

6. GENERAL OPERATING PROCEDURES

6.1 USER NOTES

NOTE

All input data entered by the system manager is in reverse type to distinguish it from the messages printed by the system. For example, this line is shown in reverse type of the style used to indicate user input.

- To facilitate interfacing with smart terminals or Personal Computers that are running 'SMART' communications programs, all output going to the system manager are always terminated in either a carriage return (ASCII HEX code 0D) or an ETX character (ASCII HEX code 03).

- All subsystem prompts always end in the sequence '>', space, ETX and the '>' is always in the 5th column, the space in the sixth and the ETX in the 7th. This should make it easier for the smart terminals to identify when they are talking to a subsystem. Examples are:

Prompt
GRD > (ETX)
SAC > (ETX)
DIAG > (ETX)
AUTH > (ETX)
BILL > (ETX)
CHAN > (ETX)
PARM > (ETX)

- All sections that require specific input from the system manager always ends with the sequence '?' or ':' followed by a space and by either a (CR) or an (ETX). Examples are:

Messages requiring user input
EXCHANGE? (ETX)
CORRECT (Y/N)? (ETX)
CHANGE TIME (HH:MM:SS) TO: (ETX)
ENTER CURRENT PASSWORD: (ETX)
ENTER AREA CODE (XXX)? (ETX)
ENTER CUSTOMER GROUP: (ETX)

- '>', ':' or '?' are the prompt message characters by which the program requests valid command word entry (from the system manager) to begin a program subroutine.

- The RUB OUT and BACKSPACE keys remove the previously entered character from the terminal's input buffer and causes the cursor or carriage to back up one character for each RUB OUT or BACKSPACE character entered. These keys are used to correct user entry errors, before the current line being entered is terminated with the (CR) key.

- Almost all inputs from the system manager must be terminated by an enter key. This may be a key marked ENTER, CARRIAGE RETURN, NEW LINE, or some other name. This is shown in text in this form: (CR).

- A few inputs need not be followed by a (CR), namely control characters. A control character is entered by pushing and holding down the CONTROL or CTRL key and striking the alphabetic key desired. In this text, a control character is indicated as a upper case CONTROL, a dash and the letter, such as CONTROL–X. CONTROL–X is often used to terminate listing, reports and tape operations. In this case, this does not need to be followed by a (CR).

- Once the system manager logs onto the system, a timer is activated. If there is no input from the user for a 5 minute period of time, the user is automatically logged off the system and the phone line is disconnected (in a dial–up connection only).

- To log off the system control program, the user must first leave a subsystem by use of the QUIT command. Then the user may issue the proper command to exit from the system.

- Whenever the system control program requests a response to a prompt ending with '(Y/ N)?', the user must enter No(CR) or N(CR) for a no answer, or, Yes(CR) or Y(CR) for a yes answer.

6.2 ACCESS TO SYSTEM CONTROL PROGRAM

Access to the system manager control program is accomplished by dialing a phone number for the system's modem (dial-up lines only) and entering a logon name and password. There are 5 logon names.

Each of the logon names have different command capabilities. For example, logon 'BILLING' can perform a BILL command but cannot issue a SAC command. Logon 'SYSTEM' can perform SAC LIST commands but cannot do a SAC EDIT command. Following is a list of the logon names available and a description of the intended usage for each:

Logon	Description
BILLING	This logon is used for those that will be downloading interconnect billing information. It will be afforded access to all billing listing type commands.
CONTROL	This logon is used to perform the various SAC functions and to control usage of system resources. This is the logon that will most often be used by the system manager.
MASTER	The MASTER logon is used to access all system functions and has the ability to change the passwords for all of the other logons.
SYSTEM OR SYSTxxxx	This is the logon normally used by service personnel. It is afforded all of the commands normally used to service systems. It is given access to all system functions required to analyze and maintain the system. The contents of all system tables and authorization settings are visible. This logon can perform listing functions in any sub-system.

When a user is ready to access the system, the system's telephone number must be called if the system is equipped with dial-up access. If the system manager terminal is locally attached, this step is not necessary. The user must then enter one or more (CR) keys until the system greets the user and asks the user for a logon name. One of the 5 logon names listed above must be entered. If an incorrect logon is entered 3 times, the logon process aborts. Dial-up lines disconnect and the system manager port does not respond for 2 minutes.

After successfully entering a logon name, the system asks for the password for that logon (unless the password was set to 'NULL' by the MASTER name). Following are the default system passwords that are in effect whenever the system is first made operational or after a memory loss:

Logon	Description
BILLING	TRUNKING
CONTROL	TRUNKING
MASTER	$MASTER$
SYSTEM OR SYSTxxxx	TRUNKING

If an incorrect password is entered 5 times, the logon process aborts. Dial-up lines disconnect and the system manager port does not respond for 2 minutes.

When the user has successfully logged onto the system, the user is given the date, time, system number, version of the CSC (and MCB, if installed) and the status of the diagnostic system. The user then sees guardian prompt 'GRD >'.

NOTE

With this new logon procedure, it is possible to emulate the method of system access used by earlier Motorola Trunked Radio Systems by using the form 'SYSTxxxx' where the system number is placed in the 'xxxx' position of the logon (for example, 'SYST0509'). The system manager must log in with the MASTER logon and change the SYSTEM logon password to 'NULL'.

It is assumed that most managers want passwords on all logons to ensure secure access to the system. For this reason, the system has been designed to prohibit the users of BILLING, CONTROL and SYSTEM logons from removing their passwords. Each of these logons has the liberty to change their passwords at any time, but the user logged on under that logon cannot remove the password. The MASTER logon alone can set a password to 'NULL'.

The system manager may logon with the MASTER logon and change passwords for each of the other logons. Refer to paragraph 8, PASSWORD command, of Instruction Section 68P81088E87 located following the COMMAND FUNCTIONS & RESPONSES divider tab of this manual for details.

Figure 6 provides samples of logons to the system. Figure 6A assumes that this is the first logon after system is powered up. Figure 6B demonstrates the case of a normal logon after the date and time are established, the diagnostics set to manual mode, and the password changed from the default. Figure 6C is for a successful logon for the SYSTEM logon where the MASTER logon has set the password to 'NULL'. Figure 6D demonstrates an illegal logon attempt where the user does not know a proper logon. Figure 6E demonstrates an illegal logon attempt where the proper password for the logon used is not known.

```
(CR)
SYSTEM 153B. LOGON PLEASE: CONTROL(CR)
ENTER PASSWORD: ........(CR)  ☜-------------------------not echoed on terminal
COPYRIGHT MOTOROLA INC. 1987.  ALL RIGHTS RESERVED.
SMARTNET SYSTEM  ☜---------------------typical system prompt; others include Privacy Plus Enhanced,
LOGGED ON AS CONTROL AT  0:00:35  SUNDAY  0/00/00  ShareNet, and SMARTWORKS II.
AUTOMATIC DIAGNOSTICS
CSC VERSION xxxx
*DIAG*  0:01:51   0/00/00  MA 00 CSC     E0 0F 0A 08
*DIAG*  0:01:51   0/00/00  MA 00 CSC     E0 0F 0E 0F
*DIAG*  0:01:51   0/00/00  MA 00 CSC     E0 0F 0E 0E
MCB VERSION xxxx

 GRD>
```

A. 1ST LOGON AFTER SYSTEM STARTUP

```
(CR)
SYSTEM 153B. LOGON PLEASE: CONTROL(CR)
ENTER PASSWORD: ......(CR)  ☜-------------------------not echoed on terminal
COPYRIGHT MOTOROLA INC. 1987.  ALL RIGHTS RESERVED.
SMARTNET SYSTEM
LOGGED ON AS CONTROL AT  8:40:35  WEDNESDAY 5/08/90
MANUAL DIAGNOSTICS
CSC VERSION xxxx
MCB VERSION xxxx

 GRD>
```

B. SUBSEQUENT LOGON

```
(CR)
SYSTEM 0509. LOGON PLEASE: SYST0509(CR)
COPYRIGHT MOTOROLA INC. 1987.  ALL RIGHTS RESERVED.
SMARTNET SYSTEM
LOGGED ON AS CONTROL AT  9:55:37   TUESDAY  5/15/90
MANUAL DIAGNOSTICS
CSC VERSION xxxx
MCB VERSION xxxx

 GRD>
```

C. LOGON WITH NO PASSWORD

```
(CR)
SYSTEM 0509. LOGON PLEASE: TEST(CR)
INVALID ID. LOGON PLEASE: JOHN(CR)
INVALID ID. LOGON PLEASE: WHAT(CR)
INVALID ID.
*** SESSION TERMINATED ***  ☜-------------------------Dial-up line disconnected at this time.
```

D. INVALID LOGON

```
(CR)
SYSTEM 153B. LOGON PLEASE: SYST153B(CR)
ENTER PASSWORD: .....(CR)  ☜-------------------------------not echoed on terminal
INVALID PASSWORD. ENTER PASSWORD: .......(CR)  ☜------not echoed on terminal
INVALID PASSWORD. ENTER PASSWORD: ........(CR)  ☜-----not echoed on terminal
INVALID PASSWORD. ENTER PASSWORD: .........(CR)  ☜----not echoed on terminal
INVALID PASSWORD. ENTER PASSWORD: ........:(CR)  ☜----not echoed on terminal
INVALID PASSWORD.
*** SESSION TERMINATED ***  ☜-------------------------Dial-up line disconnected at this time.
```

E. INVALID PASSWORD

Figure 6. System Logon Examples

After initial system start up, or after a loss of all system memory, error messages may be seen prior to the MCB version number. The system manager can change this feature so that error messages are seen only when the proper command is used to see them. Refer to paragraph 6, DIAG command, of Instruction Section 68P81088E87 located following the COMMAND FUNCTIONS & RESPONSES divider tab of this manual for details. At logon, you are told if the diagnostics are in MANUAL or AUTOMATIC mode.

LOGON Error Messages are as follows.

- PASSWORDS CORRUPTED, SET TO DEFAULTS – The system has determined that the passwords have been corrupted. The default passwords are now in effect.
- CODE PLUG PASSWORDS CORRUPTED, SET TO NULL – The system has determined that the code plug passwords have been corrupted. No passwords are in effect, having been set to null.
- DRAM MALFUNCTION IN PASSWORDS – The dynamic RAM in which the passwords reside was found to be bad. This RAM should be checked immediately and replaced, if necessary. If this error occurs, the user is automatically logged in without having to enter a password.

6.3 HELP SYSTEM

At the GRD > prompt, and at most other subcommand prompts , the word 'Help' or '?' can be entered to obtain a list of all commands that can be performed by the LOGON that was used. See HELP System Example provided in Figure 7.

6.4 TIMEOUT AND DISCONNECT CONTROL

Throughout the GUARDIAN control program, a 5–minute timer is established for every location where an input is expected from the user. If the 5 minute time limit is exceeded at any of these locations, the message '*** TIMEOUT ***' is seen and the user is logged off the system. The user then has an additional 5 minutes in which to enter a (CR) and log in again. When the time exceeds 5 minutes, then the terminal receives the message '*** SESSION TERMINATED ***' and the phone connection to the system manager port disconnects (dial–up lines only). This ensures that others can have access to the system manager port in cases where a user forgets to log off or disconnect the phone.

If the phone connection is broken while a user is logged into the system, the user is logged off. If the system is immediately re–dialed, the user has to go through the logon process again. This protects the system from unauthorized access that might occur if the system was to wait for a reconnection and resume. In this mode, there would be no way to determine who made the reconnection without demanding the user to log in again.

6.5 COMMAND INPUT

Throughout the GUARDIAN control program, commands can be entered in either lower or upper case. Password entries must be entered exactly as the password was changed, so if the password was changed to 'FunnY', it must always be entered in exactly this manner.

Most commands can be abbreviated to one or more characters. In the discussions provided in the Instruction Sections following the COMMAND FUNCTIONS & RESPONSES divider tab of this manual, the required portion of a command is shown in upper case while the optional portion is shown in lower case. When the manual refers to 'List Command', this implies that the letter 'L' alone is sufficient to identify the command. If more than the required number of characters are entered, the spelling must be correct. For example, the command 'List' can be entered as 'L', 'LI', 'LIS', 'LIST', 'l', 'li', 'lis' or 'list', for example.

```
GRD> HELP(CR)
AVAILABLE COMMANDS FOR YOUR LOGON ID ARE:
     BYE
     EXIT
     PASS
     EMRG
     DATE
     TIME
     CHAN
     PARM
     TEST
     SERV
     STAT
     DIAG
     SAC
     AFF
     AUTH
     BILL
     TEL
     VER
     MGC
     DVP
     SITE
GRD> DIAG(CR)
AUTOMATIC DIAGNOSTICS
DIAG> ?(CR)
AVAILABLE COMMANDS FOR YOUR LOGON ID ARE:
     QUIT
     CLEAR
     PRINT
     AUTOMATIC
     MANUAL
DIAG>
```

Figure 7. HELP System Examples

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COMMAND FUNCTIONS AND RESPONSES

1. INTRODUCTION

The function of each command word and valid subcommand responses are described in Table 1. The "MBCS" column shows which accounts have authorization for the command; "B" means BILLING, "C" means CONTROL, "S" means SYSTEM or SYSTxxxx, and "M" means MASTER.

When the system manager has logged on to the system, the GRD> prompt is seen on the terminal. As various subsystems are entered, the prompt changes. Return to the GRD> prompt is generally made by using the Quit command within subsystems.

There are three error messages that can be seen in response to the entry of a command. These, along with descriptions follow.

- INVALID COMMAND – The command entered was not found in the valid command table. Check spelling and proper form of the command.
- COMMAND NOT INSTALLED – The command was recognized as a known command from the tables, but the proper model and/or option has not been purchased and the necessary routines are not installed.
- YOUR ID CANNOT USE COMMAND – The command is recognized, but the logon ID that was used is not permitted to use the command (i.e., BILLING trying to perform a SAC command).

Table 1. Command Summary

Command	Para-Page	MBCS	Description	Subcommands – Minimum abbreviations in upper case
#AFF	2–2	M–CS	Establish, change, or list talkgroup to fleet affiliation.	Edit List Clear Stats Quit
*AUTH	##	MBCS	Establish, query, and/or change authorization tables.	Add Delete Edit List Mload Msave Pdigit Quit Reset Status Tran Update
*BILL	##	MBCS	Establish, query, and/or change billing parameters.	AEXC CLNG DEXC GRDD INIT LAIR LEXC LOGN LOGY LTEL MAIR MEXC MTEL PBXN PBXY QUIT RSET SAIR SLNG STEL
BYE	3–4	MBCS	Log off system.	none
CHAN	4–4	M–CS	Channel controller.	Disable Enable Status Protect Unprotect Group Add Remove Quit
**DATA	18–41	M–CS	Examine/modify data system parameters.	Stats Quit
DATE	5–10	M–CS	Query and/or change date and time.	none
DIAG	6–10	M–CS	Set diagnostic method, print/clear message.	Automatic Clear Manual Print Quit
**DVP	17–40	M–CS	Examine/modify digital voice privacy parameters.	Interconnect Update List Quit
EMGR	15–37	M–CS	Examine/modify emergency call parameters.	Top Preempt Reserve Hold List MULY MULN Quit
EXIT	3–4	MBCS	Log off system.	none
MGC	16–39	M–CS	Examine/modify multigroup call parameters.	Int Wait Quit Stat
PARM	7–13	M–CS	System time-out parameters (optional).	Carr Fade LISt MAlf Quit Recent LINk MFst Trnk
PASS	8–14	MBCS	Establish/change logon password.	none, when logged on as MASTER: BILLING MASTER CONTROL SYSTEM
SAC	9–16	M–CS	Subscriber access control.	Activate CLEar CLOad CSave Deactivate Edit LIst Options Quit SEt STats

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Table 1. Command Summary (Cont'd)

Command	Para-Page	MBCS	Description	Subcommands – Minimum abbreviations in upper case
SERV	10–29	M–CS	Interconnected shared services parameters and statistics.	Disable Enable List Quit SET SETD STats
SITE	19–42	M–CS	Query and/or change status of sites.	Disable Enable Critical Noncritical Initialize Status Quit
STAT	11–34	MBCS	Display status of system.	none
*TELL	##	M–CS	Initialize, query, and/or change CIT specifications.	Disable Enable Phone Quit Repeater Status
TEST	12–34	M–CS	Initiate system test.	none
TIME	13–37	M–CS	Query and/or change time.	none
VER	14–37	M–CS	Display system version number.	none

# AFF Command not available in Type I–only systems.
* AUTH, BILL, & TELL Commands available only with telephone interconnect options.
** Command available only if repeaters are data capable and/or DVP capable.
## Commands described in Section 68P81081E88 following TELEPHONE INTERCONNECT COMMANDS AND RESPONSES divider tab (AUTH - paragraph 2; BILL - paragraph 3).

2. AFFILIATE COMMANDS

(Refer to Figure 1.)

The AFFILIATE processor is used to manage the affiliation of a Type II talk group with a fleet number. The affiliation is required for proper operation of multigroup (fleet–wide) calls and for certain reporting functions. The AFFILIATE command is not available for Type I only systems. It is available for Type II talk groups only. The fleet number must be 4 decimal digits ranging from 0001 to 4095. Talk group IDs must begin with a "T", then an "8", followed by 5 decimal digits ranging from 00001 to 04094. These 5 digits are a direct decimal conversion of the 3 digit hexadecimal talk group ID.

Once the command is issued, the AFF > prompt is seen. Following are descriptions of the commands available to this prompt.

Command	Paragraph	Description
Edit	2.1	Add/change/delete a talk group to a fleet.
List	2.2	List talk groups associated with a fleet.
Clear	2.3	Clear entire affiliation table.
Stats	2.4	Status of talk group/fleet affiliations.
Quit	2.5	Exit to GUARDIAN prompt GRD >.

2.1 EDIT COMMAND

The EDIT command is used to add, change, or delete the affiliation between a talk group and a fleet. The syntax is the word EDIT followed by a talk group number. The AFF routine then displays the current affiliation (or a "XXXX" if there is none). If < enter > alone is typed, the affiliation remains as it was. If a new number is entered followed by < enter >, the affiliation is changed to the requested fleet number. If an "X" and < enter > is entered, any previous affiliation is removed. When a talk group is the fleetwide, or multi–group, talkgroup; that entry should be followed by an asterisk "*".

2.2 LIST COMMAND

The LIST command must be followed by the fleet number to be listed. All talk groups are listed that are affiliated with this fleet. If none are found, control returns to the AFF prompt. An "*" denotes a multi–group talk group.

2.3 CLEAR COMMAND

This command clears the entire talk group to fleet affiliation table. An "ARE YOU SURE' ' prompt precedes the clearing of the table.

2.4 STATS COMMAND

This command gives the status of the talk group to fleet affiliation table. If any talk group to fleet affiliation has been lost, STATS reports it by printing the corresponding talk group ID. When an affiliation has been lost, it is then set to 0. If more than 255 affiliations have been lost, STATS reports "ALL TALK GROUP TO FLEET AFFILIATIONS HAVE BEEN CLEARED". Once a lost affiliation has been reported, it is then considered to be valid, and, is not reported lost again.

2.5 QUIT COMMAND

This command is used to exit from AFF. Control is returned to the GRD prompt.

```
 GRD> AFF(CR)

 AFF> LIST 2011(CR)
FLEET NUMBER 2011

 AFF> EDIT T800001(CR)
AFFILIATED WITH XXXX: 2011*(CR

 AFF> EDIT T800222(CR)
AFFILIATED WITH XXXX: 2011(CR)

 AFF> LIST 2011(CR)
FLEET NUMBER 2011
    T800001*
    T800222

 AFF> EDIT T800222(CR)
AFFILIATED WITH 2011: 2033(CR)

 AFF> EDIT T800001(CR)
AFFILIATED WITH 2011*: X(CR)

 AFF> LIST 2011(CR)
FLEET NUMBER 2011

 AFF> LIST 2033(CR)
FLEET NUMBER 2033
    T800222*

 AFF> STATS(CR)
ALL TALK GROUP TO FLEET APPLICATIONS VALID.

 AFF> STATS(CR)
THESE TALK GROUP TO FLEET AFFILIATIONS HAVE BEEN CLEARED:
T800020  T800021  T800022  T800023  T800024  T800025  T800026  T800027
T800110  T800111  T800112  T800113  T800114  T800115  T800116  T800117

 AFF> CLEAR(CR)
ENTIRE TABLE TO BE CLEARED
ARE YOU SURE (Y/N)? Y(CR)

 AFF> STATS(CR)
ALL TALK GROUP TO FLEET AFFILIATIONS ARE VALID

 AFF> Q(CR)

 GRD>
```

Figure 1. Example of an AFFILIATE Session

3. EXIT/BYE COMMANDS

(Refer to Figure 2.)

EXIT and BYE commands terminate the user interface program (GUARDIAN). To resume activity, the user must initiate the logon procedures as described in the SYSTEM OVERVIEW section of this manual. After entering either of these commands, the system will wait 5 minutes for the user to enter a logon name.

If none is entered, the system issues TIMEOUT and SESSION TERMINATED messages and causes the phone connection to terminate.

4. CHAN COMMAND

(Refer to Figure 3.)

4.1 GENERAL

The CHAN command permits the systems manager to enable, disable, or check the current status of a particular channel or a group of channels. The CHAN command also allows the systems manager to display the shared user group channel mapping and to add and remove groups from a particular channel or group of channels. In this text the repeater is referred to as the channel. A list of the CHAN commands follows.

CHAN Command Summary

Command	Description
S	Displays the STATUS of a particular channel or group of channels.
E	ENABLE a particular channel or group of channels.
D	DISABLE a particular channel or group of channels.
P	PROTECT a particular channel or group of channels.
U	UNPROTECT a particular channel or group of channels.
G	Displays the status of the shared user groups for a particular channel or group of channels.
A	ADD one or more shred user groups to a particular channel or group of channels.
R	REMOVE one or more shred user groups from a particular channel or group of channels.
Q	QUIT - Exits to the GUARDIAN prompt (GRD >)

```
 GRD> BYE(CR) or EXIT(CR)
LOGGED OFF AT  8:27:41  THURSDAY  4/12/90

(CR) ☜ ------------------------------   (note absence of prompt character)
SYSTEM 153B LOGON PLEASE: SYST153B(CR)
ENTER PASSWORD: .......(CR) ☜ ---------------  (entry not displayed on terminal)
COPYRIGHT MOTOROLA INC. 1987.   ALL RIGHTS RESERVED
SMARTNET SYSTEM  ☜---------------------typical system prompt; others include Privacy Plus Enhanced,
LOGGED ON AS SYST153B AT   8:27:57  THURSDAY  4/12/90  ShareNet, and SMARTWORKS II.
MANUAL DIAGNOSTICS
CSC VERSION xxxx
MCB VERSION xxxx

 GRD> BYE(CR) or EXIT(CR)
LOGGED OFF AT  8:28:03  THURSDAY  4/12/90

*** TIMEOUT ***
*** SESSION TERMINATED *** ☜ -------------  (dial-up line disconnected at this time)
```

Figure 2. EXIT/BYE Command Example

Most of the commands accept a channel list in the form of **nn**, **nn–mm** or **ALL**. A single channel is specified by **nn** (1–21 or 1–28). A range of channels is specified by **nn–mm**. All of the INSTALLED channels are specified by **ALL**. Some of the commands accept a shared user group list **x**. **x** is one or more alphabetic characters from A through H, with characters separated with commas.

Refer to the syntax chart that follows. In the Figure 3 example, the following items pertain to status display.

- Abbreviations

ENAB : Current device status is enabled.
SW DIS : Current device status is switch disabled.
SMT DIS : Current device status is system manager disabled (see Note).
DIAG : Current device status is testing.
MALF : Current device status is malfunction.
DIS : Current device status is disabled.

NOTE

Only a RIB and TIB can be enabled and disabled from the systems manager terminal.

- If a TIB or RIB is currently disabled from the front panel and an enable request is invoked from the systems manager terminal, the request does NOT override the switch position.
- If a TIB or RIB is currently disabled from the Systems Manager Terminal and the front panel switch is cycled from disabled to enabled, the switch position does NOT override the Systems Manager Terminal.
- If there is a call currently going on and a disable request is received by the CSC, the CSC ends the call within 1 minute or when carrier is no longer received, which ever comes first.
- If the system is installed without an interconnect unit (MCB or ICU), the TRIB status is blank.
- If the system is installed without a console (TCI), the TBIM status is blank.

CHAN Command Syntax

Command	Description
S A	Display STATUS on ALL channels.
S nn	Display STATUS on channel nn.
S nn–mm	Display STATUS on channels nn through mm.
E A	ENABLE ALL channels.
E nn	ENABLE channel nn.
E nn–mm	ENABLE channels nn through mm.
D A	DISABLE ALL channels.
D nn	DISABLE channel nn.
D nn–mm	DISABLE channels nn through mm.
P A	PROTECT ALL channels.
P nn	PROTECT channel nn.
P nn–mm	PROTECT channels nn through mm.
U A	UNPROTECT ALL channels.
U nn	UNPROTECT channel nn.
U nn–mm	UNPROTECT channels nn through mm.
G A	Show GROUPS for ALL channels.
G nn	Show GROUPS for channel nn.
G nn–mm	Show GROUPS for channels nn through mm.
G C	Show GROUPS for the CRITICAL groups..
A D A x	ADD group list x to ALL channels in the DISPATCH group list..
A D nn x	ADD group list x to channel nn in the DISPATCH group list..
A D nn-nn x	ADD group list x to channels nn through mm in the DISPATCH group list..
A I A x	ADD group list x to ALL channels in the INTERCONNECT group list..
A I nn x	ADD group list x to channel nn in the INTERCONNECT group list..
A I nn-nn x	ADD group list x to channels nn through mm in the INTERCONNECT group list..
A C x	ADD group list x to the CRITICAL group list..
R D A x	REMOVE group list x from ALL channels in the DISPATCH group list..
R D nn x	REMOVE group list x from channel nn in the DISPATCH group list..
R D nn-nn x	REMOVE group list x from channels nn through mm in the DISPATCH group list..
R I A x	REMOVE group list x from ALL channels in the INTERCONNECT group list..
R I nn x	REMOVE group list x from channel nn in the INTERCONNECT group list..
R I nn-nn x	REMOVE group list x from channels nn through mm in the INTERCONNECT group list..
R C x	REMOVE group list x from the CRITICAL group list..

4.2 PROTECTING/UNPROTECTING A CHANNEL

Protecting a channel is marking the channel so that the central will make it a last choice for servicing a call request. The central will only select a protected channel if all other unprotected channels that could satisfy the request are busy. Channels could be protected for one of the following reasons: to limit the impact of interference on certain channels, keeping a paging channel as free as possible, or, keeping a secure equipment channel as free as possible, and so on.

Unprotecting a channel means removing the protected status of a channel.

```
 GRD> CHAN(CR)
CHAN> S A(CR)
CHL  RIB/RTIB  TIB      TBIM     TRIB      ASSIGNED  TYPE      KEYED  PROTECT
------------------------------------------------------------------------------
 1     ENAB    ENAB     ENAB     DIS          YES    CONTROL    YES     YES
 2     ENAB    ENAB     ENAB     ENAB         YES    VOICE      YES     NO
 3     ENAB    ENAB     ENAB     ENAB         YES    DATA       YES     NO
 4     ENAB    ENAB     ENAB     ENAB         YES    BSI        YES     NO
 5     SMT DIS SMT DIS  ENAB     DIS          NO                        NO
 6     DIAG    DIAG     DIAG     DIS          NO                        NO
 7     MALF    SW DIS   MALF     DIS          NO                        NO
 8     ENAB    SW DIS   DIS      ENAB         NO                        NO
 9     SW DIS  SW DIS   DIS      DIS          NO                        NO

CHAN> S 2(CR)
CHL  RIB/RTIB  TIB      TBIM     TRIB      ASSIGNED  TYPE      KEYED  PROTECT
------------------------------------------------------------------------------
 2     ENAB    ENAB     ENAB     ENAB         YES    VOICE      YES     NO

CHAN> S 3-6(CR)
CHL  RIB/RTIB  TIB      TBIM     TRIB      ASSIGNED  TYPE      KEYED  PROTECT
------------------------------------------------------------------------------
 3     ENAB    ENAB     ENAB     ENAB         YES    DATA       YES     NO
 4     ENAB    ENAB     ENAB     ENAB         YES    BSI        YES     NO
 5     SMT DIS SMT DIS  ENAB     DIS          NO                        NO
 6     DIAG    DIAG     DIAG     DIS          NO                        NO

CHAN> D 2(CR)

CHAN> S 2(CR)
CHL  RIB/RTIB  TIB      TBIM     TRIB      ASSIGNED  TYPE      KEYED  PROTECT
------------------------------------------------------------------------------
 2     SMT DIS SMT DIS  ENAB     ENAB         NO                        NO

CHAN> E 5(CR)

CHAN> S 5(CR)
CHL  RIB/RTIB  TIB      TBIM     TRIB      ASSIGNED  TYPE      KEYED  PROTECT
------------------------------------------------------------------------------
 5     SMT DIS SMT DIS  ENAB     DIS          NO                        NO

CHAN> P A(CR)
ARE YOU SURE (Y/N)? Y(CR)

CHAN> U 6-8(CR)
ARE YOU SURE (Y/N)? Y(CR)

CHAN> S A(CR)
CHL  RIB/RTIB  TIB      TBIM     TRIB      ASSIGNED  TYPE      KEYED  PROTECT
------------------------------------------------------------------------------
 1     ENAB    ENAB     ENAB     DIS          YES    CONTROL    YES     YES
 2     ENAB    ENAB     ENAB     ENAB         YES    VOICE      YES     YES
 3     ENAB    ENAB     ENAB     ENAB         YES    DATA       YES     YES
 4     ENAB    ENAB     ENAB     ENAB         YES    BSI        YES     YES
 5     SMT DIS SMT DIS  ENAB     DIS          NO                        YES
 6     DIAG    DIAG     DIAG     DIS          NO                        NO
 7     MALF    SW DIS   MALF     DIS          NO                        NO
 8     ENAB    SW DIS   DIS      ENAB         NO                        NO
 9     SW DIS  SW DIS   DIS      DIS          NO                        YES
```

Figure 3. CHAN Command Example (sheet 1 of 3)

```
CHAN> G A(CR)
  CHL   DISPATCH                 INTERCONNECT            IN SERVICE
---------------------------------------------------------------------------
   1    A B C D E F G H          A B C D E F G H         CONTROL
   2    A B C D E F G H          A B C D E F G H         YES
   3    A B C D E F G H          A B C D E F G H         YES
   4    A B C D E F G H          A B C D E F G H         BSI
   5    A B C D E F G H          A B C D E F G H         NO
   6    A B C D E F G H          A B C D E F G H         NO
   7    A B C D E F G H          A B C D E F G H         NO
   8    A B C D E F G H          A B C D E F G H         NO
   9    A B C D E F G H          A B C D E F G H         NO

CHAN> G 5(CR)
  CHL   DISPATCH                 INTERCONNECT            IN SERVICE
---------------------------------------------------------------------------
   5    A B C D E F G H          A B C D E F G H         NO

CHAN> G 3-7(CR)
  CHL   DISPATCH                 INTERCONNECT            IN SERVICE
---------------------------------------------------------------------------
   3    A B C D E F G H          A B C D E F G H         YES
   4    A B C D E F G H          A B C D E F G H         BSI
   5    A B C D E F G H          A B C D E F G H         NO
   6    A B C D E F G H          A B C D E F G H         NO
   7    A B C D E F G H          A B C D E F G H         NO

CHAN> R D A C,D,E,F,G,H(CR)
ARE YOU SURE (Y/N)? Y(CR)

CHAN> R I 4 G,H,E(CR)
ARE YOU SURE (Y/N)? Y(CR)

CHAN> G A(CR)
  CHL   DISPATCH                 INTERCONNECT            IN SERVICE
---------------------------------------------------------------------------
   1    A B - - - - - -          A B C D E F G H         CONTROL
   2    A B - - - - - -          A B C D E F G H         YES
   3    A B - - - - - -          A B C D E F G H         YES
   4    A B - - - - - -          A B C D - F - -         YES
   5    A B - - - - - -          A B C D E F G H         NO
   6    A B - - - - - -          A B C D E F G H         NO
   7    A B - - - - - -          A B C D E F G H         NO
   8    A B - - - - - -          A B C D E F G H         NO
   9    A B - - - - - -          A B C D E F G H         NO

CHAN> R D 4-9 A,B(CR)
ARE YOU SURE (Y/N)? Y(CR)
```

Figure 3. CHAN Command Example (sheet 2 of 3)

```
CHAN> G A(CR)
  CHL   DISPATCH              INTERCONNECT         IN SERVICE
----------------------------------------------------------------------------
   1    A B - - - - - -       A B C D E F G H      CONTROL
   2    A B - - - - - -       A B C D E F G H      YES
   3    A B - - - - - -       A B C D E F G H      YES
   4    - - - - - - - -       A B C D - F - -      YES
   5    - - - - - - - -       A B C D E F G H      NO
   6    - - - - - - - -       A B C D E F G H      NO
   7    - - - - - - - -       A B C D E F G H      NO
   8    - - - - - - - -       A B C D E F G H      NO
   9    - - - - - - - -       A B C D E F G H      NO

CHAN> A D 4-7 C,D,E,F(CR)
ARE YOU SURE (Y/N)? Y(CR)

CHAN> A D 8-9 G,H(CR)
ARE YOU SURE (Y/N)? Y(CR)

CHAN> G A(CR)
  CHL   DISPATCH              INTERCONNECT         IN SERVICE
----------------------------------------------------------------------------
   1    A B - - - - - -       A B C D E F G H      CONTROL
   2    A B - - - - - -       A B C D E F G H      YES
   3    A B - - - - - -       A B C D E F G H      YES
   4    - - C D E F - -       A B C D - F - -      YES
   5    - - C D E F - -       A B C D E F G H      NO
   6    - - C D E F - -       A B C D E F G H      NO
   7    - - C D E F - -       A B C D E F G H      NO
   8    - - - - - - G H       A B C D E F G H      NO
   9    - - - - - - G H       A B C D E F G H      NO

CHAN> G C(CR)
  CRITICAL SHARED USER GROUPS
    - - - - - - - -
CHAN> A C G,H,B,E(CR)
ARE YOU SURE (Y/N)? Y(CR)

CHAN> G C(CR)
  CRITICAL SHARED USER GROUPS
    - B - - E - G H

CHAN> R C E(CR)
ARE YOU SURE (Y/N)? Y(CR)

CHAN> G C(CR)
  CRITICAL SHARED USER GROUPS
    - B - - - - G H

CHAN> Q(CR)

 GRD>
```

Figure 3. CHAN Command Example (sheet 3 of 3)

4.3 SHARED USER SYSTEM DESIGN

The concept behind Shared User is to allow the system management a means of control whereby individual units and talk groups may be directed, or steered, to certain channels. For this purpose, all individuals and talk groups are designated as part of a larger group called a Shared User group. The 8 Shared User groups are designated A–H and assignment of units to a Shared User group is done via the SAC subscriber access control) command. (See the SAC command description in paragraph 9.) Shared User groups are then assigned to channels using the Add and Remove commands under the CHAN command processor.

While the Shared User commands allow the System Manager to assign units to Shared User groups and Shared User groups to channels in an almost limitless number of arrangements, care must be exercised to avoid compromising the efficiency of the trunked system and degrading service to the users. In general, the Shared User feature should only be used to steer call requests when there is some restriction on channel usage, such as public safety band channels on an SMR system, or when it is necessary to direct some subset of users to a channel or set of channels with special capabilities, such as secure voice or data.

NOTE

> Type II radios can be steered to a secure channel by the call request type without implementing the Shared User concept.

Shared User should NOT be used merely to provide a group of users with their own channels for the purpose of call privacy (since call reception is already limited to the transmitting unit's talk group) and doing so would destroy the efficiency inherent in a trunked system where channels are shared by many groups. If it is necessary to improve the grade of service to a particular set of users, this should be done using the priority levels adjustable through the SAC command. When the system is busy and call requests must wait to be assigned a channel, a unit with a higher priority will be the first request assigned when a channel becomes available.

An example of how to set up a Shared User system follows. Assume that there will be two Shared User groups; fleets 600 and 700 (Type I IDs) will be in one group and all other fleets will be in the second group. To set fleets 600 and 700 to Shared User group B, the following commands are entered at the SAC > prompt. (See paragraph 9.)

```
SAC> EDIT 600; SHU=B
```

Sets all fleet 600 individuals to Shared User Group B

```
SAC> EDIT 600 S; SHU=B
```

Sets all fleet 600 subfleets to Shared User Group B

```
SAC> EDIT 700; SHU=B
```

Sets all fleet 700 individuals to Shared User Group B

```
SAC> EDIT 700 S; SHU=B
```

Sets all fleet 700 subfleets to Shared User Group B

Default for all records is Shared User group A, so the rest of the records should still be set to A.

Second, the following commands entered at the CHAN > prompt will have Shared User Group A use channels 1–7 and Shared User Group B use channels 5–10. (Default for the group table is A,B,C,D,E,F,G,H.)

```
CHAN> R D A C.D.E.F.G.H(CR
```

Removes unused groups from all dispatch channels

```
CHAN> R D 1-4 B(CR)
```

Removes group B from dispatch channels 1–4

```
CHAN> R D 8-10 A(CR)
```

Removes group A from dispatch channels 8–10

Now a display of all group would indicate:

```
CHAN> G A(CR)
 CHL DISPATCH                 INTERCONNECT     IN SERVICE
----------------------------------------------------------
   1  A - - - - - - -         A B C D E F G H   YES
   2  A - - - - - - -         A B C D E F G H   CONTROL
   3  A - - - - - - -         A B C D E F G H   YES
   4  A - - - - - - -         A B C D E F G H   YES
   5  A B - - - - - -         A B C D E F G H   YES
   6  A B - - - - - -         A B C D E F G H   YES
   7  A B - - - - - -         A B C D E F G H   YES
   8  - B - - - - - -         A B C D E F G H   YES
   9  - B - - - - - -         A B C D E F G H   YES
  10  - B - - - - - -         A B C D E F G H   YES
```

The interconnect table can be set up in a similar fashion.

Now, under normal operation, requests from Shared User group A (all users except fleets 600 and 700) will be directed first to channels 1–4 and second to channels 5–7 if 1–4 are busy. Likewise, requests from Shared User group B will be assigned first to channels 8–10 and second to channels 5–7 if 8–10 are busy.

Critical Group – A Shared User group should be designated as 'critical' if it is important that the group get service even if all its normally usable channels should fail or be disabled. In such a case, the critical Shared User group would be allowed to use ANY channel that will support the call. Notice that this will NOT occur if a critical user group's channels are busy, since there would be channels that could be used by that group. Group members would still have to wait in the busy queue as if no critical groups were set. Critical group designation can only ensure that a Shared User group will get service if all of its usual channels are out of service. Proper assignment of Shared User groups to channels and maintenance of channels should prevent this from occurring.

Emergency Calls – Top–of–queue and ruthless preemption call processing – If an emergency call request cannot find a free channel within its own Shared User group, and the system is operating in top–of–queue mode, the system will transmit trunk calls on all channels that the emergency request could use. If the system is operating in ruthless preemption mode, the emergency request will only be allowed to preempt calls from its own Shared User group.

Five Channel Radios – If a radio requests a five channel, channel it is <u>always</u> steered to Shared User Group A. Care must be taken when setting up your SAC table, SAC default, and CHAN table, if your system has five channel radios.

5. DATE COMMAND

(Refer to Figure 4.)

The DATE command allows the system manager to query and/or modify the date and time of the system clock. Date and time are used by the system for 1) diagnostics, 2) alarm reporting, and 3) interconnect call processing and billing. The date format is:

DOW MM/DD/YR where: DOW = day of week
(SUNday–SATurday)
MM = month (01–12)
DD = day (01–31)
YR = year (00–99)

When the DATE command is completed, an automatic call to the TIME command is made. The format for the time is in 24 hour format as shown below:

HH:MM:SS where: HH = hour (00–23)
MM = minute (00–59)
SS = second (00–59)

The day of the week specification is required for interconnect call processing purposes. A space is required between the day of the week and the month specifications.

6. DIAG COMMAND

(Refer to Figure 5 or Figure 6.)

The DIAG command controls how error messages are presented. If the mode is set to 'MANUAL', messages are seen by calling the DIAG processor, using the PRINT command, and purging error messages with the CLEAR command. If the mode is 'AUTOMATIC', error messages appear automatically whenever the system manager terminal is connected to the trunked system. A list of the DIAG commands follows.

DIAG Command Summary

Command	Paragraph	Description
Automatic	6.1	Turns on automatic error message reporting system.
Clear	6.2	Clears all error messages from memory.
Manual	6.3	Turns off automatic error message reporting system.
Print	6.4	Prints stacked error messages
Quit	6.5	Exits to GUARDIAN prompt GRD>.

6.1 AUTOMATIC COMMAND

This command is used to turn on automatic printing of error messages. Messages will be printed when they occur, whether the system manager terminal is actually logged on or not.

6.2 CLEAR COMMAND

This command clears all error messages from memory. This command works in the mode where the automatic printing and purging of messages is not in effect (i.e., a 'MANUAL' command was made earlier). The system asks if you are sure.

6.3 MANUAL COMMAND

This command turns off the automatic mode of receiving error messages. After issuing this command, error messages are seen only when the PRINT command is given, and the messages are purged only when the CLEAR command is given. In the event the error message queue is full and a new message needs to be added, the oldest message in memory is purged to make room for the newest one.

6.4 PRINT COMMAND

This command causes DIAG to print any stored messages that are found in memory. The printing is non-destructive, i.e., the messages can be printed over and over again, unless they are cleared with the CLEAR command.

6.5 QUIT COMMAND

The QUIT command is used to exit from DIAG. Issuing this command returns the user to the GRD > prompt.

```
 GRD> DATE(CR)
CURRENT DATE (DOW MM/DD/YR) IS: SUNDAY  0/00/00
CORRECT (Y/N)? N(CR)
CHANGE DATE (DOW MM/DD/YR) TO: FRI 4/13/90(CR)
CURRENT DATE (DOW MM/DD/YR) IS: FRIDAY  4/13/90
CORRECT (Y/N)? Y(CR)
CURRENT TIME (HH:MM:SS) IS:  3:45:04
CORRECT (Y/N)? N(CR)
CHANGE TIME (HH:MM:SS) TO: 9:50:20(CR)
CURRENT TIME (HH:MM:SS) IS:  9:50:20
CORRECT (Y/N)? Y(CR)

 GRD>
```

Figure 4. DATE Command Example

```
 GRD> DIAG(CR)
MANUAL DIAGNOSTICS

DIAG> AUTO(CR)
AUTOMATIC DIAGNOSTICS

DIAG> CLEAR(CR)
ARE YOU SURE (Y/N)? N(CR)

DIAG> MAN(CR
MANUAL DIAGNOSTICS

DIAG> PRINT(CR)

*DIAG*  0:01:51   4/20/90  MA 00 CSC     E0 0F 0A 08
*DIAG*  0:01:51   4/20/90  MA 00 CSC     E0 0F 0E 0F
*DIAG*  0:01:58   4/20/90  MA 00 CSC     E0 0F 0E 0E
*DIAG*  0:02:11   4/20/90  MA 00 ICU     B8 04 00 19
*DIAG*  0:02:11   4/20/90  MA 00 ICU     B8 04 00 1A
*DIAG*  0:02:11   4/20/90  MA 00 ICU     B8 04 00 1B
*DIAG* 13:24:07   4/20/90  MA 00 CSC     E0 0F 0E 14

DIAG> PRINT(CR)

*DIAG*  0:01:51   4/20/90  MA 00 CSC     E0 0F 0A 08
*DIAG*  0:01:51   4/20/90  MA 00 CSC     E0 0F 0E 0F
*DIAG*  0:01:58   4/20/90  MA 00 CSC     E0 0F 0E 0E
*DIAG*  0:02:11   4/20/90  MA 00 ICU     B8 04 00 19
*DIAG*  0:02:11   4/20/90  MA 00 ICU     B8 04 00 1A
*DIAG*  0:02:11   4/20/90  MA 00 ICU     B8 04 00 1B
*DIAG* 13:24:07   4/20/90  MA 00 CSC     E0 0F 0E 14

DIAG> CLEAR(CR)
ARE YOU SURE (Y/N)? Y(CR)

DIAG> PRINT(CR)
NO MESSAGES

DIAG> QUIT(CR)
 GRD>
```

Figure 5. DIAG Command Example for ***SMARTNET II****,* ***Privacy Plus–Enhanced****, or* ***SmartWorks***

```
 GRD> DIAG(CR)
MANUAL DIAGNOSTICS

DIAG> AUTO(CR)
AUTOMATIC DIAGNOSTICS

DIAG> CLEAR(CR)
ARE YOU SURE (Y/N)? N(CR)

DIAG> MAN(CR
MANUAL DIAGNOSTICS

DIAG> PRINT(CR)

*DIAG*  0:01:51   4/20/90  MA 00 CSC     0E0 F 0A 08
*DIAG*  0:01:51   4/20/90  MA 00 CSC     0E0 F 0E 0F
*DIAG*  0:01:58   4/20/90  MA 00 CSC     0E0 F 0E 0E
*DIAG*  0:02:11   4/20/90  MA 00 ICU     0B8 4 00 19
*DIAG*  0:02:11   4/20/90  MA 00 ICU     0B8 4 00 1A
*DIAG*  0:02:11   4/20/90  MA 00 ICU     0B8 4 00 1B
*DIAG* 13:24:07   4/20/90  MA 00 CSC     0E0 F 0E 14

DIAG> PRINT(CR)

*DIAG*  0:01:51   4/20/90  MA 00 CSC     0E0 F 0A 08
*DIAG*  0:01:51   4/20/90  MA 00 CSC     0E0 F 0E 0F
*DIAG*  0:01:58   4/20/90  MA 00 CSC     0E0 F 0E 0E
*DIAG*  0:02:11   4/20/90  MA 00 ICU     0B8 4 00 19
*DIAG*  0:02:11   4/20/90  MA 00 ICU     0B8 4 00 1A
*DIAG*  0:02:11   4/20/90  MA 00 ICU     0B8 4 00 1B
*DIAG* 13:24:07   4/20/90  MA 00 CSC     0E0 F 0E 14

DIAG> CLEAR(CR)
ARE YOU SURE (Y/N)? Y(CR)

DIAG> PRINT(CR)
NO MESSAGES

DIAG> QUIT(CR)
 GRD>
```

Figure 6.
*DIAG Command Example for **SMARTNET II+, Privacy Plus–SE** or **Privacy Plus–Enhanced** with AMSS*

7. PARM COMMAND

(Refer to Figure 7.)

The optional PARM command provides the ability to modify, within prescribed values, selective system time-out periods. The command function has been enhanced to include specification of the number of consecutive assignments of a talk group to recent user queue. The parameters available for modification are:

- Carrier Time–Out Period – Determines the time period for which an assigned voice channel remains unmuted and active, receiving only carrier and no handshake connect tones. After the time–out expires, the channel assumes the disconnect phase. The timer can be activated after disconnect tone is detected by the central controller.
- Fade Time–Out Period – Determines the time period for which an assigned voice channel remains active with no tones or carrier received. After the time–out expires, the channel is deassigned. Timer is activated after the central controller fails to detect disconnect tone after loss of the low speed connect tone.
- Message Trunk Time–Out Period – Determines the time period for which a voice channel remains active after receiving disconnect from the subscriber unit (repeater dropout time). After the time–out expires, the channel is deassigned.
- Carrier Malfunction Time–Out Period – Determines how long an interfering carrier must be present on a deassigned channel before that channel is removed from system use. An entry of 254 seconds disables the time–out.
- Recent User Assignments – Defines the maximum number of consecutive assignments of a talk group to the high priority recent user queue. This number can be adjusted to achieve an acceptable balance between message continuity and the monopolization of the system by a large user group.
- Link Timeout to Remote Site – Determines the time period the DCB waits before malfunctioning a remote site. This is a function for simulcast operation which is not available in *Privacy Plus–Enhanced* or *SmartWorks* models.
- Minimum Failsoft Time – Determines the time period the System stays in failsoft after all conditions have been met for Trunking.

The LIST command is used to examine the various parameters. A parameter is changed by entering the command (Carr, Fade, Trnk, MAlf, Recent, Link, or MFst) followed by a space and the new parameter value. The PARM command family is exited by entering the Quit command.

Command	Parameter	Range	Default
Carrier	Carrier Timeout	0.1–6.3	0.5 Seconds
Fade	Fade Timeout	0.1–6.3	1.2 Seconds
Trunk	Message Trunk Timeout	0.1–6.3	1.0 Seconds
MAlf	Carrier Malfunction	1–253	50 Seconds
Recent	Recent User	0–255	2 Assignments
Link	Link Timeout	15–99	15 Seconds
MF	Minimum Failsoft	0:10–25:00	0:30 Seconds

```
GRD> PARM(CR)

PARM> LIST(CR)
 CARR T.O. = 0.5
 FADE T.O. = 1.2
 TRNK T.O. = 1.0
 MALF T.O. =  50
 RECENT    =   2
 LINK T.O. =  15
 MFST      =  0:30

PARM> C 1.0(CR)

PARM> T 2.0(CR)

PARM> R 5(CR)

PARM> MF 0:10(CR)

PARM> LINK 20(CR)

PARM> LIST (CR)
 CARR T.O. = 1.0
 FADE T.O. = 1.2
 TRNK T.O. = 2.0
 MALF T.O. =  50
 RECENT    =   5
 LINK T.O. =  20
 MFST      =  0:10

PARM> Q(CR)

GRD>
```

Figure 7. PARM Command Example

8. PASSWORD COMMAND

(Refer to Figure 8 and Figure 9.)

8.1 GENERAL

After a user logs on to the system, the user can change the password on that account. In the case of the MASTER logon only, passwords can be removed or changed for all logons.

To access the password command, enter 'PASS' at the GRD > prompt. To prevent an unauthorized individual from walking up to a logged–in terminal and changing the password for the account, the current password for the account is requested. After this is entered and verified, you are prompted for the new password. This new password can be composed of 4 to 8 upper or lower case alpha characters, numbers, and the special characters that appear normally in the upper case number positions on most keyboards. Punctuation and control characters are not permitted. If syntax requirements are passed, you are then prompted for the new password again. The two password inputs are compared, and if the same, become the new password.

Passwords are not displayed to the system manager terminal. Note that the password is case sensitive, so if you change the password using lower case characters, it must always be entered the same way, namely, in lower case.

If the PASS command is issued by the MASTER log on, the user is prompted for the logon to be changed. One of the four valid logons should then be entered. Then the system prompts for the passwords. Also, the MASTER logon alone can disable the password for any of the logons by changing the password for that logon to "NULL" (this must be in upper case).

NOTE

The password for SYSTEM logon applies also to the SYSTxxxx logon.

In order to afford the highest level of security, the password is not kept in memory in a readable form. Once the password is established and verified, it is then processed by a one–way algorithm to produce a bit pattern that is then stored in memory. It is then later compared to logon passwords entered. If the bit patterns match, the password entered is accepted. If they do not match, then the user is not allowed access to the system.

If a user forgets the password, it cannot be retrieved from memory. The MASTER logon can change the password, but cannot determine what the current password was. If the MASTER logon password is forgotten, that account can no longer be accessed unless the system is powered down and battery–backed RAM erased by pulling the battery jumper (JUVB +).

```
 GRD> PASS(CR)
ENTER CURRENT PASSWORD: ........(CR)  ☜ -----------  (entry not displayed on terminal)
    ENTER NEW PASSWORD: ........(CR)  ☜ -----------  (entry not displayed on terminal)
           ENTER AGAIN: .......(CR)   ☜ -----------  (entry not displayed on terminal)
PASSWORDS NOT THE SAME
CHANGE ABORTED

 GRD>
ENTER CURRENT PASSWORD: ........(CR)  ☜ -----------  (entry not displayed on terminal)
    ENTER NEW PASSWORD: ...(CR)        ☜ -----------  (entry not displayed on terminal)
PASSWORD TOO SHORT, MUST BE > 3 CHAR
CHANGE ABORTED

 GRD>
ENTER CURRENT PASSWORD: ........(CR)  ☜ -----------  (entry not displayed on terminal)
    ENTER NEW PASSWORD: .........(CR) ☜ -----------  (entry not displayed on terminal)
PASSWORD TOO LONG, MUST BE < 9 CHAR
CHANGE ABORTED

 GRD>
ENTER CURRENT PASSWORD: ........(CR)  ☜ -----------  (entry not displayed on terminal)
    ENTER NEW PASSWORD: .......(CR)   ☜ -----------  (entry not displayed on terminal)
    ENTER NEW PASSWORD: .......(CR)   ☜ -----------  (entry not displayed on terminal)
PASSWORD CHANGED

 GRD>
```

Figure 8. PASS Command Example (BILLING, CONTROL, or SYSTEM or SYSTxxxx account)

```
GRD> PASS(CR)
ENTER CURRENT PASSWORD: ........(CR) ☜ ------------ (entry not displayed on terminal)
ID TO BE CHANGED: SYSTEM(CR)
    ENTER NEW PASSWORD: NULL(CR) ☜ ----------------- (entry not displayed on terminal)
           ENTER AGAIN: NULL(CR) ☜ ----------------- (entry not displayed on terminal)
PASSWORD REMOVED

GRD> PASS(CR)
ENTER CURRENT PASSWORD: ........(CR) ☜ ------------ (entry not displayed on terminal)
ID TO BE CHANGED: BILLING(CR)
    ENTER NEW PASSWORD: .....(CR) ☜ ---------------- (entry not displayed on terminal)
           ENTER AGAIN: .....(CR) ☜ ---------------- (entry not displayed on terminal)
PASSWORD CHANGED

GRD> PASS(CR)
ENTER CURRENT PASSWORD: ........(CR) ☜ ------------ (entry not displayed on terminal)
ID TO BE CHANGED: MASTER(CR)
    ENTER NEW PASSWORD: ......(CR) ☜ --------------- (entry not displayed on terminal)
           ENTER AGAIN: ......(CR) ☜ --------------- (entry not displayed on terminal)
PASSWORD CHANGED

GRD>
```

Figure 9. PASS Command Example (MASTER account)

Even though the MASTER logon password may be lost, all other logons can still be used as long as the passwords for those accounts are known.

8.2 COMMAND MESSAGES

The following messages are displayed to the system manager as prompts or when an error is detected in the information being given to the system.

- CHANGE ABORTED – The password was not changed. The reason for the abort is listed on the previous line.
- ENTER AGAIN: – Enter the new password a second time. This verifies that the new password entered is what is intended. This is necessary since the password entered is not displayed.
- ENTER CURRENT PASSWORD: – Enter the current password for the account you logged into. This is requested so that an unauthorized individual cannot walk up to an unprotected terminal and change the password.
- ENTER NEW PASSWORD: – Enter the new password you want.
- ID TO BE CHANGED: – ‘MASTER’ logon is performing the PASS command. Enter the logon ID that is to have its password changed: ‘BILLING’, ‘CONTROL’, ‘MASTER” or ‘SYSTEM’.
- ONLY MASTER CAN USE ‘NULL‘ – A user who is not logged in as ‘MASTER’ attempted to remove a password.
- PASSWORD CANNOT HAVE CONTROL CHAR – The new password entered contains an illegal character. Perform the PASS command again.
- PASSWORD CHANGED – The password has been successfully changed.
- PASSWORD NOT MATCHED – The password entered for verification is not the proper password for the logon ID used. Perform the PASS command again.
- PASSWORD REMOVED – The password has been removed from the logon.
- PASSWORD TOO LONG, MUST BE < 9 CHAR – The new password entered is too long. It must be 4 to 8 characters in length. Perform the PASS command again.
- PASSWORD TOO SHORT, MUST BE > 3 CHAR – The new password entered is too short. It must be 4 to 8 characters in length. Perform the PASS command again.
- PASSWORDS CORRUPTED, SET TO DEFAULTS – The system has determined that the passwords have been corrupted. The default passwords are now in effect.
- PASSWORDS NOT THE SAME – The two entries of the new password did not agree. Perform the PASS command again.

- SYSTEM ERROR – The system has made an error and cannot determine who is logged into the system. The user will be logged off and will have to log in again before the PASS command can be executed.
- DRAM MALFUNCTION IN PASSWORDS – The dynamic RAM in which the passwords reside was found to be bad. This RAM should be checked immediately and replaced if necessary. No passwords are allowed to be changed until the error is corrected.

9. SAC COMMAND – SUBSCRIBER ACCESS CONTROL

9.1 USER RECORDS – *SMARTNET II* ID SCHEME

The user data base consists mainly of two types of records, talk group and individual. Each record specifies attributes (for an individual or talk group) specifying how a unit may use the system.

The ID scheme consists of Type I and Type II IDs. Following is a description of the ID structure for the protocol used in *SMARTNET II*, *Privacy Plus–Enhanced* and *SmartWorks* systems.

TYPE I IDs

The ID scheme for Type I IDs in your new system remains the same as in *SMARTNET I* or *Privacy Plus* systems. That is, we continue to use the hexadecimal fleet–subfleet–individual convention. Individual IDs are referenced by a 3–digit hexadecimal fleet number, ranging from 000 to 77F, followed by a 3–digit hexadecimal individual number, ranging from 000 to FFE. Subfleets are also referenced by the same fleet number followed by a 2–digit hexadecimal subfleet number, ranging from 00 to 0F. All the aforementioned ranges are dependent upon the size code.

When the subfleet ID is entered at the System Manager's Terminal, the subfleet portion must be preceded with an 'S' to distinguish it from the individual ID.

Example	Description
705 001	Fleet 705, individual 1
10F 30F	Fleet 10F, individual 30F
405 S01	Fleet 405, subfleet 1
600 S0A	Fleet 600, subfleet A

TYPE II IDs

The Type II ID is referenced with a 6–digit decimal number. This number is the same as the Type II land–to–mobile interconnect and Private Call II IDs.

Individual IDs must begin with a '7' followed by 5 decimal digits ranging from 00001 to 65534. These 5 digits are a direct decimal conversion of the 4–digit hexadecimal ID. Talk group IDs must begin with an '8' followed by 5 decimal digits ranging from 00001 to 04094. Once again, these 5 digits are a direct decimal conversion of the 3–digit hexadecimal talk group ID.

When a Type II ID is entered for a 'SAC' command, it must be preceded by an 'I' or 'T', for individual or talk group, respectively. This is to distinguish Type I and Type II IDs.

Example	Description
I705001	Individual 5001
I700235	Individual 235
T800001	Talk group 1
T800300	Talk group 300

Type II i causes loss of first 1C type I individual ID's

Example 1: Type I, Individual

```
FLT  UNT ENA EP2 FIX AMS PRL SYW MGC TGW PVC INT DRG 821 PAG DAT SEC SHU
400  001  Y   Y   N   N   3   N   Y   Y   N   Y   Y   N   N   N   N   A
```

Example 2: Type I, Talk Group

```
FLT  SUBFLT ENA MFL PMG AMS PRL PR2 PTI 821 SEC SHU
001    01    Y   N   N   N   8   N   N   N   N   A
```

Example 3: Type II, Individual

```
UNIT     ENA EP2 FIX AMS PRL SYW MGC TGW PVC INT DRG 821 PAG DAT SEC SHU
I700123   Y   Y   N   N   3   N   Y   Y   N   Y   Y   N   N   N   N   A
```

Example 4: Type II, Talk Group

```
TALK GRP  ENA MFL PMG AMS PRL PR2 PTI 821 SEC SHU
T800001    Y   -   N   N   8   -   -   N   N   A
```

Example 5: Type II, Individual

```
UNIT     ENA EP2 FIX AMS PRL SYW MGC TGW PVC INT DRG 821 PAG DAT SEC SHU
I700123   Y   Y   N   N   6   N   N   Y   N   Y   N   N   N   N   N   C
```

Example 6: Type II, Talk Group

```
TALK GRP  ENA MFL PMG AMS PRL PR2 PTI 821 SEC SHU
T800001    Y   -   N   N   6   -   -   N   N   C
```

Figure 10. Individual and Talk Group Attribute Examples

9.1.1 Individual Attributes

This is a description of the attributes that are listed in an individual subscriber record. Refer to Figure 10.

- ENA – (Enable) – Y indicates that the individual is allowed to use the system when the Subscriber function is active. The system uses the default records when the Subscriber function is inactive.

- EP2 – (Enhanced Protocol II) – Y indicates that the individual does not perform high speed handshake. For Type II units, this flag will always be set, and, cannot be modified since these units never perform high speed handshaking.

- FIX – (Fixed Location) – Y indicates that the individual has a fixed location, such as a console. N indicates that the individual has a mobile location.

- AMS – (Automatic Multiple Site Switching) – Y indicates that an individual is allowed to make a wide area (AMSS) call. This feature is used only from the RCSC when there are wide and local channels. Note that this field is disabled unless system is an AMSS RCSC. Default is set to disabled.

- PRL – (Priority Level) – Priority levels (2–8) (2–5 for *SmartWorks* Models) can be set in allocating system resources to the unit. In the case where the unit and talk group have different priorities, the central controller will use the higher priority (lower number). Priority applies to both dispatch and interconnect calls.

- SYW – (System Wide) – Y indicates the unit is allowed to make a system wide call. The unit must be equipped with the system wide call option. With *SmartWorks,* this field is disabled, unless equipped with D565 option. Default is set to disabled.

- MGC – (Multi–Group Call) – Y indicates that the unit is allowed to make multi-group (fleet-wide/announcement) calls. With *SmartWorks,* this field is disabled, unless equipped with D565 option. Default is set to enabled.

- TGW – (Talk Group Wide) – Y indicates that the unit is allowed to make a talk group wide call. With *SmartWorks,* this field is disabled, unless equipped with D565 option. Default is set to enabled.

- PVC – (Private Call) – Y indicates the unit is allowed to make a private call. The unit must be equipped with one of the private call options.

- INT – (Interconnect Call) – Y indicates the unit is allowed to make a telephone interconnect call. The unit must be capable of making an interconnect call and must be on the authorization list if it is active. Note that with *SmartWorks* models this field is always enabled for all users and cannot be disabled from the SMT. Interconnect control can still be managed by authorizing only those users that have interconnect capability.

- DRG – (Dynamic Regrouping) – Y indicates that the unit is allowed to initiate dynamic regrouping commands (open gateway). Note that this field is disabled for *Privacy Plus–Enhanced* models unless equipped with a D554 *ShareNet* upgrade option. With *SmartWorks* models this field is always disabled (unless equipped with a D429 upgrade option); the Selective Radio Inhibit feature is always enabled for all users and is not controlled by the DRG field.

- 821 (821 MHz capable) – Y indicates that the subscriber can synthesize 821 MHz frequencies.

- PAG – (Paging Request) – Y indicates that the unit is allowed to make a paging request. Note that with *SmartWorks* models this field is always enabled for all users and cannot be disabled from the SMT.

- DAT – (Data Request) – Y indicates that the unit is allowed to make a data request.

- SEC – (Secure Communications) – N (Normal) indicates that the talk group is allowed to make clear (non–coded) calls only. S (Secure) indicates that the talk group can make secure (coded) calls only. B (Both) indicates that the talk group is allowed o make both clear and secure calls. Note that with *SmartWorks* models this field is always enabled (both clear and coded calls allowed) for all users and cannot be disabled from the SMT.

- SHU – (Shared User) – Individual users are grouped into one of eight shared user groups (A–H). **Five channel requests are steered to Shared User Group A.**

All the options are followed by an equal sign and the new value for that option. All options except for PRL, SEC, and SHU use the character "N" for NO and "Y" for YES. As previously described, PRL uses numbers 2– 8, SEC uses letters N, S, and B, and SHU uses letters A–H. The command and ID field are followed by a semicolon(;), then the option(s) and new value(s). For example, with `I700123;ENA=Y,SYW=N,PRL=6,INT=Y,SHU=C` in the ID/option field there is correspondence with Example 5 of Figure 10.

Use of the option field is described in paragraph 9.6 for EDIT and 9.7 for LIST. If an "*" is specified in the option field, e.g., I700123;*, then the work space record is filled with the default record, described in paragraph 9.1.3. Each position in the workspace may only be specified once, meaning that each option may only appear once.

9.1.2 Talk Group Attributes

This is a description of the attributes that are listed in a talk group record. Refer to Figure 10.

- ENA – (Enable) – Y indicates that the talk group is allowed to use the system when the Subscriber function is active. The system uses the default records when the Subscriber function is inactive.

- MFL – (Mixed Fleet) – Y indicates that the fleet is mixed (contains Type I AND Type II IDs). N indicates Type I IDs only. This option is used for Type I fleet–subfleet records only, and is only editable on a fleet basis.

- PMG – (Priority Monitor Group) – Y indicates that the talk group is a priority monitor group. Note that this field is disabled for *Privacy Plus–Enhanced* models unless equipped with a D554 *ShareNet* upgrade option. With *SmartWorks* models this field is always disabled unless equipped with a D566 option.

- AMS – (Automatic Multiple Site Switching) – Y indicates that a talk group is allowed to make a wide area (AMSS) call. This feature is used only from the RCSC when there are wide and local channels. This field is disabled unless system is on AMSS RCSC. Default is set to disabled.

- PRL – (Priority Level) – Priority levels (2–8) (2–5 for *SmartWorks* Models) can be set in allocating system resources to the talk group. In the case where the unit and talk group have different priorities, the central controller uses the higher priority (lower number). Priority applies to both dispatch and interconnect calls.

- PR2 – (Normal/Tactical Priority Level) – Normal or Tactical priority levels can be set through a console in assigning system resources to the talk group. Y indicates that the talk group is set to tactical (priority level of 2). N indicates there is no tactical priority, and, the talk group is set back to its normal priority level. Normal/Tactical priority changes can only be made through a console and do not apply to the default record.

- PTI – (Push–To–Talk ID) – Y indicates that the talk group operates using PTT ID. This option is used for Type I fleet–subfleet records only and is only editable on a fleet basis.

- 821 (821 MHz capable) – Y indicates that the talk group can synthesize 821 MHz frequencies.

- SEC – (Secure Communications) – N (Normal) indicates that the talk group is allowed to make clear (non–coded) calls only. S (Secure) indicates that the talk group can make secure (coded) calls only. B (Both) indicates that the talk group is allowed to make both clear and secure calls. Note that with *SmartWorks* models this field is always enabled (both clear and coded calls allowed) for all users and cannot be disabled from the SMT.

- SHU – (Shared User) – Talk group users are grouped into one of eight shared user groups (A–H). **Five channel requests are steered to Shared User Group A.**

All the options are followed by an equal sign and the new value for that option. All options except for PRL, SEC, and SHU use the character 'N ' for NO and 'Y' for YES. As previously described, PRL used numbers 2–8, SEC uses letters N, S, and B, and SHU uses letters A–H. The command and ID field are followed by a semicolon(;), then the option(s) and the new value(s). For example, with `T800001;ENA=Y,PMG=N,AMS=N,PRL=6,SHU=C` in the ID/option field there is correspondence with Example 6 of Figure 10.

Use of the option field is described in the sections for LIST and EDIT. If an '*' is specified in the option field, e.g., T800001;*, then the workspace record is filled with the default record, described in paragraph 9.1.3. Each position in the workspace may only be specified once, meaning that each option may only appear once.

9.1.3 Default Records

If the data for a particular unit is lost, the system will replace the data with the appropriate default record. These records, one for individuals, and one for talk groups, have the same format as the records described in paragraphs 9.1.1 and 9.1.2. They can be operated on by specifying 'I*' or 'T*' instead of an individual or talk group ID. This allows the system manager to specify what grade of service a user will receive if his record is lost. It also allows the default records to be modified so they can be used with certain subscriber commands. (See command descriptions, paragraph 9.2.)

IMPORTANT

When the system manager is finished working with the default records, they should be set so that an acceptable level of service is provided for any user whose record may be lost.

If the default records are lost, then the system replaces them with default records stored in the central controller code plug. The code plug default records are programmed in the factory.

9.2 COMMAND SUMMARY

SAC Command Summary

Command	Paragraph	Description
OPTions	9.3	Lists available options.
ACTivate	9.4	Activates an individual subscriber unit.
DEActivate	9.5	Deactivates an individual subscriber unit.
Edit	9.6	Edit subscriber/talk group records.
List	9.7	List subscriber/talk group records.
STAts	9.8	Display/alter status.
CLEar	9.9	Clears all records to codeplug defaults.
SET	9.10	Sets all records to default values.
CSAve	9.11	Saves intelligent memory.
CLOad	9.12	Reloads intelligent memory.
Quit	9.13	Exits to GUARDIAN prompt GRD >.

```
GRD> SAC(CR)
SAC> OPT(CR)
 ENA = Y/N
 EP2 = Y/N
 FIX = Y/N
 AMS = Y/N
 PRL = 2-8
 SYW = Y/N
 MGC = Y/N
 TGW = Y/N
 PVC = Y/N
 INT = Y/N
 DRG = Y/N
 821 = Y/N
 PAG = Y/N
 DAT = Y/N
 SEC = N/S/B
 SHU = A-H
 MFL = Y/N
 PMG = Y/N
 PTI = Y/N
SAC>
```

Figure 11. SAC Options Command Example

```
 GRD> SAC(CR)

 SAC> ACT 001 3(CR) ☜ ------------- (Type I)

 SAC> ACT 112(CR) ☜ --------------- (Type I)
ARE YOU SURE (Y/N)? Y(CR)

 SAC> ACT I700123(CR) ☜ ---------- (Type II)

 SAC> ACT I700123-I700125(CR) ☜ --(Type II)
ARE YOU SURE (Y/N)? Y(CR)

 SAC> ACT I*(CR)

 SAC> Q(CR)

 GRD>
```

Figure 12. SAC Activate Command Examples

9.3 OPTIONS COMMAND

(Refer to Figure 11.)

This command prints the abbreviations for the user attributes that the system manager is allowed to modify, along with their associated values that can be set.

9.4 ACTIVATE COMMAND

(Refer to Figure 12.)

This command is used to put an individual in the active records list. When a record is activated, it gets the same attributes as the default record. For Type I, an individual or a fleet of individual records can be activated. An individual or range of individual IDs can also be activated for Type II.

For Type I, if an entire fleet is activated, or for Type II, if a range of individuals is activated, then the system asks 'ARE YOU SURE (Y/N)?' before continuing.

The default record is set active by specifying 'I*' instead of an individual ID.

```
  GRD> SAC(CR)

  SAC> DEA 001 3(CR) ☜ ------------ (Type I)

  SAC> DEA 112(CR) ☜ -------------- (Type I)
ARE YOU SURE (Y/N)? Y(CR)

  SAC> DEA I700123(CR) ☜ --------- (Type II)

  SAC> DEA I700123-I700125(CR) ☜ --(Type II)
ARE YOU SURE (Y/N)? Y(CR)

  SAC> Q(CR)

  GRD>
```

Figure 13. SAC Deactivate Command Examples

9.5 DEACTIVATE COMMAND

(Refer to Figure 13.)

This command 1) deactivates an individual record or a fleet of individual records for Type I or 2) deactivates an individual record or a range of individual records for Type II. When a record has been deactivated, it can no longer be listed, modified or used until it is activated again. Once an individual record has been re–activated, it is replaced with the default record. Therefore, this command should not be used to temporarily deny service to a unit. The default record can be deactivated by specifying "I*", however, it can still be listed but not modified. Fleet–subfleet/talk group records cannot be deactivated since they are always considered active. DEACTIVATE also asks 'ARE YOU SURE (Y/N)?' when an entire fleet is deactivated for Type I or a range of individuals is deactivated for Type II.

9.6 EDIT COMMAND

(Refer to Figure 14.)

This command changes the SAC attributes for any individual record, fleet–subfleet/talk group record, individual default record, or fleet–subfleet/talk group default record. These records may be changed one at a time for Type I and Type II, by entire fleets for Type I, or by ranges of individuals or by talk groups for Type II.

The EDIT command has two parts to its input field. The first part is the ID field as described in paragraph 9.1. The ID field is followed by a semicolon and then the second part (option field) which tells what attributes are to be changed. The attribute names are those listed in paragraph 9.3 for the OPTIONS command. The names are followed by an equal sign and the desired setting. Valid settings are also shown in paragraph 9.3. Default records may be modified by specifying 'I*' for the individual record or 'T*' for the talk group record. After a single record is modified, the record is listed to confirm the change. If the EDIT is for an entire fleet in Type I, or a range of records in Type II, the system asks 'ARE YOU SURE (Y/N)?' before proceeding. Individual records may only be modified if they are active.

```
 GRD> SAC(CR)

 SAC> EDIT 400 1:INT=Y.PVC=N.PRL=3(CR)  ☜ ---------------------------------- (Type I)
FLT  UNT ENA EP2 FIX AMS PRL SYW MGC TGW PVC INT DRG 821 PAG DAT SEC SHU
400  001  Y   Y   N   N   3   N   Y   Y   N   Y   Y   N   N   N   N   A

 SAC> EDIT 400: SYW=Y.PVC=Y(CR)  ☜ ------------------------------------------ (Type I)
ARE YOU SURE (Y/N)? Y(CR)

 SAC> EDIT 001 S1; ENA=Y,PMG=N(CR)    ☜ ------------------------------------- (Type I)
FLT  SUBFLT ENA MFL PMG AMS PRL PR2 PTI 821 SEC SHU
001    01    Y   N   N   N   8   N   N   N   N   A

 SAC> EDIT 001 S: MFL=Y(CR)  ☜ ---------------------------------------------- (Type I)
ARE YOU SURE (Y/N)? Y(CR)

 SAC> EDIT I700123: INT=T.PVC=N.PRL=3.821-Y(CR)  ☜ ------------------------ (Type II)
UNIT      ENA EP2 FIX AMS PRL SYW MGC TGW PVC INT DRG 821 PAG DAT SEC SHU
I700123    Y   Y   N   N   3   N   Y   Y   N   Y   Y   Y   N   N   N   A

 SAC> EDIT I700123-I700129: SYW=Y.PVC=Y(CR)  ☜ ---------------------------- (Type II)
ARE YOU SURE (Y/N)? Y(CR)

 SAC> EDIT T800001; ENA=Y,PMG=N(CR)  ☜ ------------------------------------ (Type II)
TALK GRP  ENA MFL PMG AMS PRL PR2 PTI 821 SEC SHU
T800001    Y   -   N   N   8   -   -   N   N   A

 SAC> EDIT T800001-T800008; MFL=Y(CR)  ☜ ---------------------------------- (Type II)
ARE YOU SURE (Y/N)? Y(CR)

 SAC> EDIT I*; MGC=Y(CR)
UNIT      ENA EP2 FIX AMS PRL SYW MGC TGW PVC INT DRG PAG 821 DAT SEC SHU
 I*        Y   Y   N   N   8   N   Y   Y   Y   Y   Y   N   N   N   N   A

 SAC> EDIT T*; ENA=Y,821=Y(CR)
TALK GRP  ENA MFL PMG AMS PRL PR2 PTI 821 SEC SHU
   T*      Y   -   N   N   8   -   -   Y   -   A

 SAC> Q(CR)

 GRD>
```

Figure 14. SAC EDIT Command Examples

9.7 LIST COMMAND

(Refer to Figure 15.)

The LIST subcommand displays any record or related group of records. Like the EDIT subcommand, LIST has two parts to its input field. If the ID field is blank, all the individual records are listed. If all individual records, an entire fleet for Type I, or a range of records for Type II is requested, the option field can specify that only records with certain attributes be listed. The option field has the same syntax as the EDIT subcommand. Individual records may only be listed if they are active. The default records, both individual and fleet–subfleet/talk group, can be examined by specifying 'I*' and 'T*', respectively. If a list of all records is requested, a form feed character is sent before each 56 IDs. Typing control–X at any time stops a LIST command and returns the system to the SAC prompt.

```
GRD> SAC(CR)

SAC> LIST 400 1(CR)   ☜ ------------------------------------------------------- (Type I)
FLT   UNT  ENA  EP2  FIX  AMS  PRL  SYW  MGC  TGW  PVC  INT  DRG  PAG  821  DAT  SEC  SHU
400   001   Y    Y    N    N    3    N    Y    Y    Y    Y    Y    N    N    N    N    A

SAC> LIST 400(CR)   ☜ ---------------------------------------------------------- (Type I)
FLT   UNT  ENA  EP2  FIX  AMS  PRL  SYW  MGC  TGW  PVC  INT  DRG  PAG  821  DAT  SEC  SHU
400   000   N    Y    N    N    8    N    Y    Y    Y    Y    Y    N    N    N    N    A
400   001   Y    Y    N    N    3    N    Y    Y    N    Y    Y    N    N    N    N    A
400   002   N    Y    N    N    8    N    Y    Y    N    Y    Y    N    N    N    N    A
400   003   Y    Y    N    N    3    N    Y    Y    Y    Y    Y    N    N    N    N    A
400   004   N    Y    N    N    3    N    Y    Y    Y    Y    Y    N    N    N    N    A
400   005   Y    Y    N    N    8    N    Y    Y    N    Y    Y    N    N    N    N    A
400   006   Y    Y    N    N    8    N    Y    Y    N    Y    Y    N    N    N    N    A
400   007   Y    Y    N    N    8    N    Y    Y    Y    Y    Y    N    N    N    N    A

SAC> LIST 400: ENA=Y,PVC=Y(CR)   ☜ ------------------------------------------- (Type I)
FLT   UNT  ENA  EP2  FIX  AMS  PRL  SYW  MGC  TGW  PVC  INT  DRG  PAG  821  DAT  SEC  SHU
400   003   Y    Y    N    N    3    N    Y    Y    Y    Y    Y    N    N    N    N    A
400   007   Y    Y    N    N    8    N    Y    Y    Y    Y    Y    N    N    N    N    A

SAC> LIST 405 S; ENA=N(CR)   ☜ ----------------------------------------------- (Type I)
FLT   SUBFLT  ENA  MFL  PMG  AMS  PRL  PR2  PTI  821  SEC  SHU
405     01     N    N    N    N    8    N    N    N    N    A
405     04     N    N    N    N    8    N    N    N    N    A
405     0C     N    N    N    N    8    N    N    N    N    A

SAC> I700123-I700129; INT=Y,FIX=N(CR)   ☜ --------------------------------- (Type II)
UNIT       ENA  EP2  FIX  AMS  PRL  SYW  MGC  TGW  PVC  INT  DRG  PAG  821  DAT  SEC  SHU
I700123     Y    Y    N    N    3    Y    Y    Y    Y    Y    Y    N    N    N    N    A
I700125     Y    Y    N    N    8    Y    Y    Y    Y    Y    Y    N    N    N    N    A
I700128     Y    Y    N    N    8    Y    Y    Y    Y    Y    Y    N    N    N    N    A

SAC> LIST T800001(CR)   ☜ ------------------------------------------------------ (Type II)
TALK GRP   ENA  MFL  PMG  AMS  PRL  PR2  PTI  821  SEC  SHU
T800001     Y    -    N    N    8    -    -    N    N    A

SAC> LIST T800001-T800008; PMG=Y(CR)   ☜ ---------------------------------- (Type II)
TALK GRP   ENA  MFL  PMG  AMS  PRL  PR2  PTI  821  SEC  SHU
T800002     Y    -    Y    N    8    -    -    N    N    A
T800004     Y    -    Y    N    8    -    -    N    N    A
T800005     Y    -    Y    N    8    -    -    N    N    A
T800006     Y    -    Y    N    8    -    -    N    N    A

SAC> LIST I*(CR)
UNIT       ENA  EP2  FIX  AMS  PRL  SYW  MGC  TGW  PVC  INT  DRG  PAG  DAT  821  SEC  SHU
 I*         Y    Y    N    N    8    N    Y    Y    Y    Y    Y    N    N    N    N    A

SAC> LIST T*(CR)
TALK GRP   ENA  MFL  PMG  AMS  PRL  PR2  PTI  821  SEC  SHU
   T*       Y    -    N    N    8    -    -    N    -    A

SAC> Q(CR)

GRD>
```

Figure 15. SAC LIST Command Examples

```
 GRD> SAC(CR)
 SAC> STATS(CR)
THESE RECORDS HAVE BEEN SET TO DEFAULT:

T800260   T800261   T800262   T800263   T800264   T800265   T800266   T800267
400 S00   400 S01   400 S02   400 S03   400 S04   400 S05   400 S06   400 S07

I700800   1700801   I700802   I700803   I700804   I700805   I700806   I700807
604 008   604 009   604 00A   604 00B   604 00C   604 00D   604 00E   604 00F

SUBSCRIBER FUNCTION IS INACTIVE
CHANGE TO ACTIVE (Y/N))? Y(CR)

 SAC> STATS(CR)

SUBSCRIBER FUNCTION IS ACTIVE
REMAIN ACTIVE (Y/N))? N(CR)

 SAC> Q(CR)

 GRD>
```

Figure 16. SAC STATS Command Example

```
 GRD> SAC(CR)

 SAC> CLEAR(CR)
ARE YOU SURE (Y/N)? Y(CR)

RECORDS CLEARED
SUBSCRIBER TURNED OFF

 SAC>
```

Figure 17. SAC CLEAR Command Example

```
 GRD> SAC(CR)

 SAC> SET(CR)
ARE YOU SURE (Y/N)? Y(CR)

RECORDS SET
SUBSCRIBER TURNED OFF

 SAC>
```

Figure 18. SAC SET Command Example

9.8 STATS COMMAND

(Refer to Figure 16.)

The STATS command has a dual function. First, if any records have been lost and set to default, STATS reports it by printing the lost IDs. Second, it always reports the state (active/inactive) of the SAC system and asks if it should be changed. Both Type I and Type II IDs are reported with the same command. If more then 255 records have been lost, STATS reports 'ALL SUBSCRIBER RECORDS HAVE BEEN SET TO DEFAULT'.

9.9 CLEAR COMMAND

(Refer to Figure 17.)

The CLEAR command places all SAC records into a known state. When this subcommand is entered, the default values for subscriber records stored in the code plug are copied into the default records. The default records are then copied into all SAC records. Once all records have been 'cleared', the individual default record is activated and the SAC status is set to inactive.

NOTE

The CLEAR command should be performed, followed by the SET command, after the CSC board has lost power for an extended period of time. This is because all subscriber records will have been lost (as reported by the STAT command) and should be initialized to a known state.

9.10 SET COMMAND

(Refer to Figure 18.)

The SET subcommand also places all SAC records into a known state. When this command is entered, the default values for subscriber records are copied into all SAC records and the SAC status is set to inactive.

NOTE

The SET command should be performed, preceded by the CLEAR command, after the CSC board has lost power for an extended period of time. This is because all subscriber records will have been lost (as reported by the STATS command) and should be initialized to a known state.

9.11 CSAVE COMMAND

The CSAVE command causes the central controller to send a copy of memory to a recording device. This command works similarly to the old SAVE command. The difference is that this command is used to save records to an intelligent device instead of to a tape machine. A System Manager's Terminal (SMT) node is needed on the intelligent end.

With the previous SAVE, if any record is received in error, a tape machine can only send a control–X to abort the download of data, then must start the process all over again. CSAVE allows an error free saving of data without the need for VERIFY or repeated attempts to save data.

The CSAVE command is designed to save talk groups, talk group–to–fleet affiliations, and only those individual records that the manager has ACTIVE on the system. Therefore, it is very important that the manager DEACTIVATE any individual records that are not being used. Otherwise, ALL individuals are saved since they are set to ACTIVE. This greatly increases the time required for the command to save the SAC database. Assuming a 2400 baud rate for example, in a Type II system consisting of 4000 mobile units, a CSAVE performed with unused individuals left ACTIVE requires approximately 1 hour and 50 minutes. With unused individual records DEACTIVATED, the CSAVE command requires about 15 minutes.

9.12 CLOAD COMMAND

The CLOAD command causes the central controller to read data from an intelligent storage device, check the data received, and, if valid, place this data into memory at the proper location. This command works similarly to the old LOAD command. The difference is that this command is used to load records from an intelligent device instead of from a tape machine. An SMT node is needed on the intelligent end.

With the previous LOAD, if any record is received in error, the central aborts the load. Then the process must be started all over again manually. CLOAD allows an error free loading of data without the need for repeated attempts to load the data. The subscriber function is set to inactive whenever the CLOAD subcommand is used.

9.13 QUIT COMMAND

The QUIT command exits SAC and returns back to the GRD > prompt.

9.14 SUBSCRIBER RECORD ERROR DETECTION/CORRECTION

Within the subscriber software package are routines designed to detect errors in the subscriber data base. If a record is found to be bad, it is set to default and marked as lost. The system then sends the appropriate diagnostic message, stating that some data was lost. The system manager should then use the STATS command to see what records were lost so they can be corrected. The system keeps a count of lost records, and, if more than 255 have been lost, sends a diagnostic message stating that all records have been lost (this is the likely case). The best thing to do is to reload the records from the optional backup device. The lost record count is cleared whenever the STATS command is run.

If the CSC board loses power for an extended period of time, all data is lost and the error correcting routine sends the corresponding diagnostic message. However, there is a small chance that the error correcting routine will not correct a block of memory, thinking it is already correct. For this reason, it is important to do a 'CLEAR' and 'SET' whenever an 'ALL RECORDS LOST' message is received.

9.15 SAC ERROR MESSAGES

The following messages are displayed at the system manager terminal when an error is detected in the information being given to the system.

- BAD INPUT – A good ID field was found initially, but was followed by bad data.
- CHECKSUM ERROR – A checksum error was detected in the subscriber records. The requested operation was aborted and the error correcting routine was run.
- INVALID OPTION – An option was specified that was not included with the purchased option package.
- INVALID TALK GROUP, INVALID INDIVIDUAL – The indicated portion of the ID field was defective or value not in a valid range.
- NO MATCHING RECORDS – LIST could not find any records that matched the specified option list. If a single ID was specified, it was not active.
- OPTIONS NOT ALLOWED – ID field was followed by a semicolon in a command where options are not allowed.
- OPTIONS ONLY ALLOWED ONCE – An option number was specified more than once in an option field.
- PRIORITY ONLY ALLOWED ONCE – More than one priority number (2–8) was specified in an option field.
- RECORD ALREADY ACTIVE – The ACTIVE command was tried on an active record.
- RECORD NOT ACTIVE – A LIST or EDIT command was tried on an inactive record.
- ID ERROR IN CODEPLUG – Code plug is set up incorrectly for Type I and Type II ID ranges.
- INVALID ID TYPE – This ID does not fall within the valid range for the type of ID entered (Type I or Type II). On a *CoveragePLUS* system (option D610), this ID is part of the temporary ID pool (see section 9.16).
- NUMBER OUT OF RANGE – Number entered does not fall within valid limits.
- INVALID DRAM PAGE – ID went past end of code plug ID type partitioning table. This table may be set up improperly in the code plug.

9.16 SAC OPERATION ON A *CoveragePLUS* SYSTEM (OPTION D610)

On a *CoveragePLUS* system, a number of IDs will be assigned to a pool of temporary IDs for use by *CoveragePLUS* roaming units. The SAC records for these IDs will be controlled by the *CoveragePLUS* system. Therefore, the SMT operator will not be able to edit, activate, or deactivate these records. If an attempt is made to edit, activate, or deactivate a temporary ID or a range which includes one or more temporary IDs, the operation will not be allowed, and a SAC error message, "INVALID ID TYPE", will be displayed.

9.17 USING SUBSCRIBER ACCESS CONTROL

There are two basic methods that can be used to control system access. The first way is to activate and enable all units on the system and then deny service to selected units by disabling them (this is known as 'negative subscriber' method). Disabling rather than deactivating a unit leaves it in the subscriber list so it may be re–enabled without having to change its attributes. The other method is to activate and enable only those units that are allowed service (this is known as 'positive subscriber' method).

Examples of setting up the subscriber data base for 'positive' and 'negative" subscriber systems are provided in Figure 19 and Figure 20, respectively. The actual sequence varies depending on the system requirements.

In either case, it should be remembered that the default record determines: 1) what kind of service a unit receives if its record is lost, and, 2) what level of service everyone receives if subscriber is deactivated. Therefore, whenever the default record is modified, the system manager should be sure that the is left with an acceptable level of service.

```
 GRD> SAC(CR)

 SAC> CLEAR(CR)
ARE YOU SURE (Y/N)? Y(CR)

RECORDS CLEARED
SUBSCRIBER TURNED OFF

 SAC> LIST I*(CR)
UNIT      ENA EP2 FIX AMS PRL SYW MGC TGW PVC INT DRG 821 PAG DAT SEC SHU
 I*        Y   N   N   N   8   N   Y   Y   Y   Y   Y   N   N   N   N   A

 SAC> EDIT I*: PVC=N(CR)
UNIT      ENA EP2 FIX AMS PRL SYW MGC TGW PVC INT DRG 821 PAG DAT SEC SHU
 I*        Y   N   N   N   8   N   Y   Y   N   Y   Y   N   N   N   N   A

 SAC> DEA I*(CR)

 SAC> SET(CR)
ARE YOU SURE (Y/N)? Y(CR)
RECORDS SET
SUBSCRIBER TURNED OFF

 SAC> ACT I700123-I700140(CR)
ARE YOU SURE (Y/N)? Y(CR)

 SAC> ACT I700800(CR)

 SAC> ACT I700803(CR)

 SAC> LIST I700800-I700805(CR)
UNIT      ENA EP2 FIX AMS PRL SYW MGC TGW PVC INT DRG 821 PAG DAT SEC SHU
I700800    Y   N   N   N   8   N   Y   Y   N   Y   Y   N   N   N   N   A
I700803    Y   N   N   N   8   N   Y   Y   N   Y   Y   N   N   N   N   A

 SAC> EDIT I*;PVC=Y,INT=N(CR)
RECORDS NOT ACTIVE

 SAC> ACT I*(CR)
 SAC> EDIT I*;PVC=Y,INT=N(CR)
UNIT      ENA EP2 FIX AMS PRL SYW MGC TGW PVC INT DRG 821 PAG DAT SEC SHU
 I*        Y   N   N   N   8   N   Y   Y   Y   N   Y   N   N   N   N   A

 SAC> ACT I700260-I700270(CR)
ARE YOU SURE (Y/N)? Y(CR)

 SAC> EDIT I700267; ENA=Y(CR)
UNIT      ENA EP2 FIX AMS PRL SYW MGC TGW PVC INT DRG 821 PAG DAT SEC SHU
I700267    Y   N   N   N   8   N   Y   Y   Y   N   Y   N   N   N   A

 SAC>
```

Figure 19. Positive Subscriber Example (sheet 1 of 2)

```
 SAC> EDIT I700268: SYW=Y(CR)
UNIT      ENA EP2 FIX AMS PRL SYW MGC TGW PVC INT DRG 821 PAG DAT SEC SHU
I700268    Y   N   N   N   8   Y   Y   Y   Y   N   Y   N   N   N   A

 SAC> EDIT I700267-I700268: SYW=Y(CR)
ARE YOU SURE (Y/N)? Y(CR)

 SAC> EDIT T800001: ENL=Y(CR)
TALK GRP   ENA MFL PMG AMS PRL PR2 PTI 821 SEC SHU
T800001     Y   -   N   N   8   -   -   N   N   A

 SAC> LIST T800001-T800012(CR)
TALK GRP   ENA MFL PMG AMS PRL PR2 PTI 821 SEC SHU
T800001     Y   -   N   N   8   -   -   N   N   A
T800002     Y   -   N   N   8   -   -   N   N   A
T800003     Y   -   N   N   8   -   -   N   N   A
T800004     Y   -   N   N   8   -   -   N   N   A
T800005     Y   -   N   N   8   -   -   N   N   A
T800006     Y   -   N   N   8   -   -   N   N   A
T800007     Y   -   N   N   8   -   -   N   N   A
T800008     Y   -   N   N   8   -   -   N   N   A
T800009     Y   -   N   N   8   -   -   N   N   A
T800010     Y   -   N   N   8   -   -   N   N   A
T800011     Y   -   N   N   8   -   -   N   N   A
T800012     Y   -   N   N   8   -   -   N   N   A

 SAC> STAT(CR)

SUBSCRIBER FUNCTION IS INACTIVE
CHANGE TO ACTIVE (Y/N)? Y(CR)

 SAC> QUIT(CR)

 GRD>
```

Figure 19. Positive Subscriber Example (sheet 2 of 2)

NOTES FOR POSITIVE SUBSCRIBER EXAMPLE	
CLEAR	Initializes subscriber records before they are first entered. Do only the first time that records are entered.
LIST I*	List unit default record.
EDIT I*;PVC=N	Disable private call in the default record. Note: The default record is used when a unit is activated.
LIST I*	List unit default record.
DEA I*	Deactivate the default record.
SET	Move the default record into all subscriber records.
ACT I700123–I700140	Activate units I700123 through I700140.
ACT I700800	Activate unit I700800.
ACT I700803	Activate unit I700803.
LIST I700800–I700805	List units I700800 thru I700805, inclusive.
EDIT I*;PVC=Y,INT=N	List units I700800 thru I700805, inclusive. Enable private call & disable interconnect in default record.
ACT I*	Activate the default record.
EDIT I*;PVC Y,INT N	Enable Private Call, Disable interconnect. The default record is used when a unit is activated.
ACT I700260–I700270	Activate units I700260 through I700270.
EDIT I700267;ENA Y	Edit unit I700267, enable the unit.
EDIT I700268;SYW Y	Edit unit I700268, allow system–wide calls.
EDIT I700267–I700268;INT=Y	Edit units 0007 & 0008, allow interconnect.
EDIT T800001;ENA Y	Edit talk group T800001 enable the talk group.
LIST T800001–T800012	List talk groups T800001 through T800012.
STAT	All through activating and editing units. Turn the subscriber function ON.

```
 GRD> SAC(CR)

 SAC> CLEAR(CR)
ARE YOU SURE (Y/N)? Y(CR)

RECORDS CLEARED
SUBSCRIBER TURNED OFF

 SAC> LIST I*(CR)
UNIT      ENA EP2 FIX AMS PRL SYW MGC TGW PVC INT DRG 821PAG DAT SEC SHU
 I*        Y   N   N   N   8   N   Y   Y   Y   Y   Y   N   N   N   N   A

 SAC> EDIT I*: MGC=N.PVC=N(CR)
UNIT      ENA EP2 FIX AMS PRL SYW MGC TGW PVC INT DRG 821 PAG DAT SEC SHU
 I*        Y   N   N   N   8   N   N   Y   N   Y   Y   N   N   N   N   A

 SAC> LIST T*(CR
TALK GRP  ENA MFL PMG AMS PRL PR2 PTI 821 SEC SHU
   T*      Y   -   N   N   8   -   -   N   N   A

 SAC> SET(CR)
ARE YOU SURE (Y/N)? Y(CR)
RECORDS SET
SUBSCRIBER TURNED OFF


 SAC> LIST I700800-I700809(CR
UNIT      ENA EP2 FIX AMS PRL SYW MGC TGW PVC INT DRG 821 PAG DAT SEC SHU
I700800    Y   N   N   N   8   N   Y   Y   N   Y   Y   N   N   N   N   A
I700801    Y   N   N   N   8   N   Y   Y   N   Y   Y   N   N   N   N   A
I700802    Y   N   N   N   8   N   Y   Y   N   Y   Y   N   N   N   N   A
I700803    Y   N   N   N   8   N   Y   Y   N   Y   Y   N   N   N   N   A
I700804    Y   N   N   N   8   N   Y   Y   N   Y   Y   N   N   N   N   A
I700805    Y   N   N   N   8   N   Y   Y   N   Y   Y   N   N   N   N   A
I700806    Y   N   N   N   8   N   Y   Y   N   Y   Y   N   N   N   N   A
I700807    Y   N   N   N   8   N   Y   Y   N   Y   Y   N   N   N   N   A
I700808    Y   N   N   N   8   N   Y   Y   N   Y   Y   N   N   N   N   A
I700809    Y   N   N   N   8   N   Y   Y   N   Y   Y   N   N   N   N   A

 SAC> EDIT I700123-1700140: ENA=N(CR)
ARE YOU SURE (Y/N)? Y(CR)

 SAC> EDIT I700800: ENA=N(CR)
UNIT      ENA EP2 FIX AMS PRL SYW MGC TGW PVC INT DRG 821 PAG DAT SEC SHU
I700800    N   N   N   N   8   N   N   Y   N   Y   Y   N   N   N   N   A

 SAC> EDIT I700809: ENA=N(CR)
UNIT      ENA EP2 FIX AMS PRL SYW MGC TGW PVC INT DRG 821 PAG DAT SEC SHU
I700809    N   N   N   N   8   N   N   Y   N   Y   Y   N   N   N   N   A

 SAC>
```

Figure 20. Negative Subscriber Example (Sheet 1 of 2)

```
 SAC> LIST I700800-I700809(CR)
UNIT      ENA EP2 FIX AMS PRL SYW MGC TGW PVC INT DRG 821 PAG DAT SEC SHU
I700800    N   N   N   N   8   N   Y   Y   N   Y   Y   N   N   N   N   A
I700801    Y   N   N   N   8   N   Y   Y   N   Y   Y   N   N   N   N   A
I700802    Y   N   N   N   8   N   Y   Y   N   Y   Y   N   N   N   N   A
I700803    Y   N   N   N   8   N   Y   Y   N   Y   Y   N   N   N   N   A
I700804    Y   N   N   N   8   N   Y   Y   N   Y   Y   N   N   N   N   A
I700805    Y   N   N   N   8   N   Y   Y   N   Y   Y   N   N   N   N   A
I700806    Y   N   N   N   8   N   Y   Y   N   Y   Y   N   N   N   N   A
I700807    Y   N   N   N   8   N   Y   Y   N   Y   Y   N   N   N   N   A
I700808    Y   N   N   N   8   N   Y   Y   N   Y   Y   N   N   N   N   A
I700809    N   N   N   N   8   N   Y   Y   N   Y   Y   N   N   N   N   A
 SAC> LIST I*(CR)
UNIT      ENA EP2 FIX AMS PRL SYW MGC TGW PVC INT DRG 821 PAG DAT SEC SHU
 I*        Y   N   N   N   8   N   N   Y   N   Y   Y   N   N   N   N   A

 SAC> STAT(CR)

SUBSCRIBER FUNCTION IS INACTIVE
CHANGE TO ACTIVE (Y/N)? Y(CR)

 SAC> QUIT(CR)

 GRD>
```

Figure 20. Negative Subscriber Example (Sheet 2 of 2)

NOTES FOR NEGATIVE SUBSCRIBER EXAMPLE	
CLEAR	Initialize subscriber records before they are first entered. Do only the first time that records are entered.
LIST I*	List unit default record.
EDIT I*;FLW=N,PVC=N	Disable fleetwide and private calls in the default record.
LIST T*	List talk group default record.
SET	Move the default record into all subscriber records.
LIST I700800–I700809	List units I700800 thru I700809, inclusive.
EDIT I700123–I700140;ENL=N	Disable units I700123 & I700140.
EDIT I700800;ENL=N	Disable unit I700800
EDIT I700809;ENL=N	Disable unit I700809
LIST I700800–I700809	List units I700800 thru I700809, inclusive.
LIST I*	List unit default record.
STAT	All through activating and editing units.Turn the subscriber function ON.

10. SERV COMMANDS – (Interconnect Shared Service Algorithm)

10.1 GENERAL

The interconnect shared service command family provides the system manager with those commands necessary to query and/or modify parameters that affect operation of the shared service algorithm. The interconnect parameter limits can be adjusted to meet the demands of traffic based upon time of day as well as the preference of the system owner for grade of service of dispatch versus interconnect call traffic. The parameters are as follows:

- Target Average Dispatch Busy Delay
- Target Average Interconnect Busy Delay
- Repeaters Reserved For Dispatch Calls (yes/no)
- Minimum No. of Repeaters Usable for Interconnect
- Maximum Interconnect Time–out
- Minimum Interconnect Time–out
- Minimum No. of Repeaters Usable for Data

A basic understanding of the operation of the shared service algorithm is helpful in selecting parameter values from a preset factory programmed table (see Table 2).

10.1.1 Update Interval

Every 15 minutes the shared service algorithm updates the interconnect call time–out length and the maximum number of simultaneous interconnect calls allowed. The parameter update is based upon the average access delay

Table 2. Shared Service Parameters

Parameter	Table Entry Number							
	0	1	2	3	4	5	6	7
Target Average Dispatch Delay (seconds)	5	5	2	2	5	5	2	5
Target Average Interconnect Delay (seconds)	30	30	12	30	30	30	30	30
Repeaters Reserved for Dispatch	Y	N	Y	Y	Y	Y	N	Y
Minimum Number of Interconnect Repeaters	1	1	1	1	1	1	3	0
Minimum Number of Data Repeaters	#	#	#	#	#	#	#	#
Maximum Interconnect Timeout (minutes)	8	15	10	4	5	3	25	8
Minimum Interconnect Timeout (minutes)	2	4	3	2	1	.5	3	3

NOTE

Table entry number 0 is the default number programmed into the system for weekdays 6 AM to 6 PM. Table entry number 1 is the default number programmed into the system for the weekends (all times) and weekdays 6 PM to 6 AM. Table entry 2 contains values for a lightly–loaded system. Table entries 3, 4, and 5 favor dispatch and table entry 6 favors interconnect. Table entry 7 allows the system to shut out interconnect calls during peak dispatch periods.

# this value will have to be set by the system manager.

for dispatch and interconnect calls and the erlang load of dispatch traffic.

10.1.2 Adjustment of Simultaneous Interconnect Calls

The number of simultaneous interconnect calls allowed is adjusted in two stages.

- First Stage – A calculation of the dispatch erlangs used during the previous 15 minute interval reserves a specific number of repeaters for dispatch–only use for the next interval. No repeaters are reserved, however, if the shared service parameter table indicates ‘0’ in the Repeaters Reserved for Dispatch entry.
- Second Stage – Comparison of the actual average dispatch access delay measured on the system during the last 15 minute interval to the target value determines whether the number of simultaneous interconnect calls allowed is increased, decreased or left unchanged.

When the average dispatch delay is less than the target value, the shared service algorithm increases the number of interconnect calls allowed.

The number of simultaneous interconnect calls allowed is not increased to a value greater than that consistent with the number of repeaters for dispatch, as determined in the first stage. If the algorithm attempts to do this, the value is set consistent with the reserved number.

When the average dispatch delay is greater than the target value, the shared service algorithm increases the number of interconnect calls allowed.

The number of simultaneous interconnect calls allowed is not decreased to a value less than that consistent with the minimum number of repeaters usable for interconnect. If the algorithm attempts to do this, the value is not changed, but the interconnect call time–out is decreased (subject to the minimum interconnect time–out) to service more interconnect calls per unit time.

NOTE

The second stage of adjustment is not performed if the algorithm is disabled (see DISABLE command paragraph).

10.1.3 Interconnect Time–Out Adjustment

In addition to the previously described adjustments, the Interconnect Call Time–Out is modified as follows:

- The shared service algorithm increases the interconnect time–out by doubling the present value if the interconnect delay is below its target values.
- The shared service algorithm decreases the interconnect time–out by one–half if the interconnect delay exceeds its target value.

NOTE

The interconnect time–out is subject to maximum and minimum default values as specified in Table 2.

10.1.4 Data Channel Adjustment

The number of data channels allowed is adjusted based on the intensity of dispatch traffic. If dispatch traffic is very high, the shared service routine will attempt to limit the number of data channels after the routing reduces interconnect capabilities to a minimum. The shared service routing will reduce one data channels every 15 minute interval until the number of data channels reaches a minimum or dispatch traffic can be serviced properly by the number of channels it has available.

NOTE

> The data channels will only be limited if it is allowed by the system configuration. The number of data channels that can be limited are subject to set maximum and minimum values as specified by the shared service table.

If a data system is in reduced mode the number of assigned data channels will be the number of default data channels in the system.

10.2 SUMMARY OF COMMANDS

SERV Command Summary

Command	Paragraph	Description
Disable	10.6	Disables algorithm from adjusting parameters from set limits.
Enable	10.5	Disables algorithm from adjusting parameters from set limits.
List	10.3	Lists shared service parameters.
Quit	10.9	Exits to GUARDIAN prompt GRD >.
SET	10.4	Edits shared service parameters.
SETD	10.8	Edits dispatch timeout parameters.
STats	10.7	Lists system call processing statistics.
LIMits	10.9	Edit and list shared service tables.

10.3 LIST COMMAND

(Refer to Figure 21.)

The LIST command allows the system manager to display the shared service parameter table and dispatch timeout table entries that are assigned for each 2 hour period of a day, be it a weekday or a weekend (see Table 2 for additional details).

For the shared service parameter table entries, the first number at the left of each response line defines the table entry number assigned to the service algorithm for the 2 hour time period from 12 midnight to 1:59 AM; the last entry on the right is for the time period from 10 PM to 11:59 PM.

Dispatch table entries correspond to two hour periods in a like manner. (Note that the dispatch timeout function is not related to the shared service algorithm, refer to paragraph 10.8.) When this function is disabled in the code plug, only the shared service table entries are displayed.

10.4 SET COMMAND

(Refer to Figure 22.)

The SET command allows the system manager to edit the parameter table entry number assigned to a 2 hour period of a day. The command format is SET WEEKDAY HH N or SET WEEKEND HH N. HH is the hour of the day and N is a parameter table entry number from 0–7. A space is required between each field.

```
 GRD> SERV(CR)

SERV> LIST(CR)
SHARED SERVICE TABLES

WEEKDAY:  1 1 1 0 0 0 0 0 0 1 1 1
WEEKEND:  1 1 1 1 1 1 1 1 1 1 1 1

DISPATCH TIMEOUTS

WEEKDAY:  1.0 1.0 1.0 1.0 1.0 1.0 1.0 1.0 1.0 1.0 1.0 1.0
WEEKEND:  1.0 1.0 1.0 1.0 1.0 1.0 1.0 1.0 1.0 1.0 1.0 1.0
SERV> Q(CR)

 GRD>
```

Figure 21. LIST Command Example

```
GRD> SERV(CR)

SERV> SET WEEKDAY 02 4(CR)
SERV> SET WEEKEND 23 3(CR)
SERV> LIST(CR)
SHARED SERVICE TABLES

WEEKDAY:  1 4 1 0 0 0 0 0 0 1 1 1
WEEKEND:  1 1 1 1 1 1 1 1 1 1 1 3

DISPATCH TIMEOUTS

WEEKDAY:  1.0 1.0 1.0 1.0 1.0 1.0 1.0 1.0 1.0 1.0 1.0 1.0
WEEKEND:  1.0 1.0 1.0 1.0 1.0 1.0 1.0 1.0 1.0 1.0 1.0 1.0
SERV> Q(CR)

GRD>
```

Figure 22. SET Command Example

10.5 ENABLE COMMAND

(Refer to Figure 23.)

The ENABLE command allows the shared service algorithm to adjust the number of simultaneous interconnect calls and the maximum interconnect call length to values within the parameter set limits depending on dispatch and interconnect access delays. The system default is with the algorithm enabled.

```
GRD> SERV(CR)

SERV> ENABLE(CR)
SERV> Q(CR)

GRD>
```

Figure 23. ENABLE Command Example

10.6 DISABLE COMMAND

(Refer to Figure 24.)

The DISABLE command prohibits the shared service algorithm from adjusting any set parameters based on access delays. The maximum number of simultaneous interconnect calls for the disabled mode is equal to the total number of active repeaters minus the number of repeaters reserved for dispatch. The number of repeaters reserved for dispatch is determined by the dispatch erlang load as described for the first stage in paragraph 10.1.2. The maximum interconnect call length is set to the value of the minimum interconnect time–out.

```
GRD> SERV(CR)

SERV> DISABLE(CR)
SERV> Q(CR)

GRD>
```

Figure 24. DISABLE Command Example

10.7 STATS COMMAND

(Refer to Figure 25.)

The STats command allows the system manager to obtain an output listing of system statistics pertaining to dispatch and interconnect call processing. The output is selectable for the following time periods: Instantaneous (current 15 minute parameter update period), Yesterday (each 15 minute period of the previous day) and Today (each 15 minute period of the current day). Column headings for the NO TAG example are explained in Table 3.

Table 3. Explanation of STats Display Headings

Heading	Description
DATE/TIME	Date/time of report
AVG DISP DELAY	Average dispatch delay in seconds
AVG INTR DELAY	Average interconnect delay in seconds
#SIMU INTR CALLS	Number of simultaneous interconnect calls (maximum possible)
INTR TIME OUT	Interconnect call timeout in minutes
# OF ACTIVE REPEATERS	Number of active repeaters
# OF DISP CALS	Number of dispatch calls

```
 GRD> SERV(CR)

SERV> STATS INST(CR)
  DATE     AVG    AVG   #SIMU  INTR   # OF    # OF   # OF    AVG    AVG   # OF  # OF
 4/19/90   DISP   INTR   INTR  TIME  ACTIVE   DISP   INTR   DISP   INTR   DISP  INTR
  TIME    DELAY  DELAY  CALLS   OUT   RPTRS  CALLS  CALLS  LNGTH  LNGTH   BUSY  BUSY
12:15:00   1.5   15.4     3     5.0    15     165     80    16.3   2.1      5    11

SERV> STATS TODAY(CR)
  DATE     AVG    AVG   #SIMU  INTR   # OF    # OF   # OF    AVG    AVG   # OF  # OF
 4/19/90   DISP   INTR   INTR  TIME  ACTIVE   DISP   INTR   DISP   INTR   DISP  INTR
  TIME    DELAY  DELAY  CALLS   OUT   RPTRS  CALLS  CALLS  LNGTH  LNGTH   BUSY  BUSY
00:00:00   0.0    0.0    10     8.0    15      25     10    10.2   5.9      0     2
00:00:00   0.0    0.0    10     8.0    15      15     12    17.4   2.5      0     6
....
....
....
12:15:00   1.5   15.4     3     5.0    15     165     80    16.3    2.1     5    11

SERV> STATS YES(CR)
  DATE     AVG    AVG   #SIMU  INTR   # OF    # OF   # OF    AVG    AVG   # OF  # OF
 4/18/90   DISP   INTR   INTR  TIME  ACTIVE   DISP   INTR   DISP   INTR   DISP  INTR
  TIME    DELAY  DELAY  CALLS   OUT   RPTRS  CALLS  CALLS  LNGTH  LNGTH   BUSY  BUSY
00:00:00   0.0    0.0    11     8.0    15      13      5    13.7   1.5      0     0
00:00:00   0.0    0.0    11     8.0    15      22     12    17.1   2.5      0     0
....
....
....
23:30:00   0.0    0.0     9    10.0    15       7      3    18.1   2.2      0     0
23:45:00   0.0    0.0     9    10.0    15      19      2     9.7   1.8      0     0

SERV> Q(CR)

 GRD>
```

Figure 25. STats Command Example

Table 3. Explanation of STats Display Headings (Cont'd.)

Heading	Description
`# INTR CALLS`	Number of interconnect calls
`AVG DISP LNGTH`	Average dispatch call length in seconds
`AVG INTR LNGTH`	Average interconnect call length in minutes
`# OF DISP BUSY`	Number of dispatch busies
`# OF INTR BUSY`	Number of interconnect busies

NOTE

The INTR TIME OUT and the AVG. INTR LENGTH are displayed as minutes and 10ths of minutes.

10.8 SETD COMMAND

(Refer to Figure 26.)

The SETD command allows the operator to edit the dispatch timeout assigned to a 2 hour period of a day. The command format is SETD WEEKDAY HH N.N or SETD WEEKEND HH N.N. HH is the hour of the day and N.N is a number of minutes from 0.5 to 3.0. A space is required between SETD, WEEKDAY or WEEKEND, HH, and N.N fields. The SETD command rounds the number of minutes entered to the nearest half–minute (.5 or .0). This command is only available if the dispatch timeout table is enabled in the code plug.

10.9 LIMITS COMMAND

The LIMits command allows the system manager to list and edit the shared service table settings. These parameters control the target dispatch and interconnect delays, the minimum number of interconnect and data resources allowed, the number of reserved dispatch repeaters, and the maximum and minimum interconnect timeout.

10.9.1 Summary of Commands

LIMITS COMMANDS		
Command	**Paragraph**	**Description**
List	10.9.2	List the shared service tables
Edit	10.9.3	Edit the shared service tables
Quit	10.9.4	Exits to the SERV prompt

```
 GRD> SERV(CR)

SERV> SETD WEEKDAY 02 0.5(CR)
SERV> SETD WEEKEND 23 2.0(CR)
SERV> LIST(CR)
SHARED SERVICE TABLES

WEEKDAY:  1 4 1 0 0 0 0 0 0 1 1 1
WEEKEND:  1 1 1 1 1 1 1 1 1 1 1 3

DISPATCH TIMEOUTS

WEEKDAY:  1.0 0.5 1.0 1.0 1.0 1.0 1.0 1.0 1.0 1.0 1.0 1.0
WEEKEND:  1.0 1.0 1.0 1.0 1.0 1.0 1.0 1.0 1.0 1.0 1.0 2.0
SERV> Q(CR)

 GRD>
```

Figure 26. SETD Command Example

```
 SERV> LIMITS(CR)
 LIMIT> LIST(CR)

  TABLE  DISP     PHONE    DISP      MIN PHONE   MIN DATA   MAX PHONE  MIN PHONE
   NO.   DELAY    DELAY  REPEATERS   REPEATERS   REPEATERS   TIMEOUT    TIMEOUT
    0     2.0     12.0       0           0           0          60         60
    1     4.9     29.9       0           1           0          15          4
    2     1.9     11.9       1           1           0          10          3
    3     1.9     29.9       3           1           0           4          2
    4     4.9     29.9       2           1           0           5          1
    5     4.9     29.9       3           1           0           3          0
    6     1.9     29.9       0           3           0          25          3
    7     4.9     29.9       1           0           0           8          3
  LIMIT> QUIT(CR)

  SERV>
```

Figure 27. List Command Example

10.9.2 List Command

(Refer to Figure 27.)

The LIST sub command allows the system manager to display all eight of the shared service tables. These tables contain the parameters used to set the two hour period of a day dispatch target delay, interconnect target delay, reserved dispatch repeaters, minimum number of interconnect repeaters, minimum number of data repeaters, maximum interconnect time out, and minimum interconnect time out values.

10.9.3 Edit Command

(Refer to Figure 28.)

The EDIT command allows the system manager to edit the parameters of the shared service tables. The command format is EDIT # (*the # is a valid Table number*). The system manager terminal will prompt for the new values for that particular shared service table. The questions are:

- TARGET DISPATCH DELAY (2–5 SEC)?
- TARGET PHONE DELAY (12–30 SEC)?
- REPEATERS RESERVED FOR DISPATCH? (0–27)
- MINIMUM # OF SIMULTANEOUS PHONE CALLS? (0–27)
- MINIMUM # OF DATA CHANNELS? (0–27)
- MAXIMUM PHONE TIMEOUT (00:00 – 01:30)?
- MINIMUM PHONE TIMEOUT (00:00 – 01:30)?

NOTE

When the system manager edits a shared service table, all that shared service table parameters must be reentered. The system manager cannot edit only one parameter in a table.

```
LIMIT> EDIT 5(CR)

TARGET DISPATCH DELAY (2-5 SEC)? 5(CR)
TARGET PHONE DELAY (12-30 SEC)? 25(CR)
REPEATERS RESERVED FOR DISPATCH? 15(CR)
MINIMUM # OF SIMULTANEOUS PHONE CALLS? 10(CR)
MINIMUM # OF DATA CHANNELS? 5(CR)
MAXIMUM PHONE TIME OUT (00:00 - 24:00)? 24:00(CR)
MINIMUM PHONE TIME OUT (00:00 - 24:00)? 2:35(CR)

LIMIT> QUIT(CR)
SERV>
```

Figure 28. Edit Command Example

```
GRD> STAT(CR)

 STATUS OF SYSTEM 0023 AT  9:58:35  FRIDAY  4/20/90

 CENTRAL CONTROLLER          ACTIVE MAIN
 SUBSCRIBER ACCESS CONTROL   INACTIVE
 SHARED SERVICE              ACTIVE
 DIAGNOSTICS                 AUTOMATIC
 AUTHORIZATION LIST          INACTIVE  ☜ --------------------------  (Options D401 & D163 only)
 BILLING CALCULATIONS        DISABLED  ☜ --------------------------  (Options D401 & D163 only)
 LOGGING                     TOLL CALLS ONLY  ☜ -------------------  (Options D401 & D163 only)
 PBX PROCESSING              DISABLED  ☜ --------------------------  (Options D401 & D163 only)

GRD>
```

Figure 29. STAT Command Example

10.9.4 Quit Command

The QUIT command exits from LIMits. Control is returned to the SERV prompt.

10.10 QUIT COMMAND

The QUIT command exits from SERV. Control is returned to the GRD > prompt.

11. STAT COMMAND

(Refer to Figure 29.)

The STAT command allows the system manager to query the system status. It displays central controller, SAC, shared service, diagnostic, and interconnect settings.

12. TEST COMMAND

The TEST command activates the software Diagnostic System Test. It is identical to the manual test performed when activated by the front panel TEST pushbutton (see Figure 30) on the Central Site Controller module. The software Diagnostic System Test includes tests on all three site controller boards (the CSC, RSC and TSC) and all equipped optional controller boards (the MCB, DCB/ADCB, and SAB).

NOTE

At the 2400 hour (12:00 Midnight) rollover time as determined by the system realtime clock, the Diagnostic System Test is automatically activated **if enabled** in the code plug. The actual start of the test is deferred until there is no current active voice channel communications. When all voice channels are unused, the test begins. The contrl channel is designated, and a complete software Diagnostic System Test is performed. The outcome of the test is the same as if initiated via the front panel TEST pushbutton on the CSC module.

TEST Command Example

```
GRD> TEST(CR)
```

NOTE

A simple procedure to find the cause of failure is, with alarms enabled, to either perform a manual system reset (via the CSC RESET pushbutton) or perform a system reset (via the system manager terminal). To cause a system reset from the terminal, enter `(ESC)*` . The TEST command, unlike a CSC RESET, will wait for all calls to end before performing a test.

The tests on the CSC are:

- A test of each RAM integrated circuit.
- A test of each EPROM integrated circuit using a checksum process (sum of bytes in each EPROM should equal a specified number).
- A test on battery backed memory.

The tests on the RSC are:

- A test of each RAM integrated circuit.
- A checksum test of the EPROM integrated circuit.
- An IRB check.
- An RIB check – tone detectors.

The tests on the TSC are:

- A test of each RAM integrated circuit.
- A test of each EPROM integrated circuit using a checksum process.
- A TIB check – keys channels and checks transmitter status.

The tests on the MCB (With Options D163 or D401) are:

- A test of each RAM integrated circuit.
- A test of each EPROM integrated circuit using a checksum process.

The tests on the PLIB are:

- A test of each RAM integrated circuit.
- A test of each EPROM integrated circuit using a checksum process.
- A DTMF loopback test.
- A dial tone detect test.
- A TELCO line test.
- A matrix vertical test (part of matrix board).

The tests on the DCB/ADCB are:

- A test of each RAM integrated circuit.
- A checksum test of the EPROM integrated circuit.

The tests on the SAB are:

- A test of each RAM integrated circuit.
- A checksum test of the EPROM integrated circuit.
- An SIB cneck — all audio paths are connected and proper path status return is verified.

Various trunked radio system central controller RAM and EPROM test failure indications occur when either

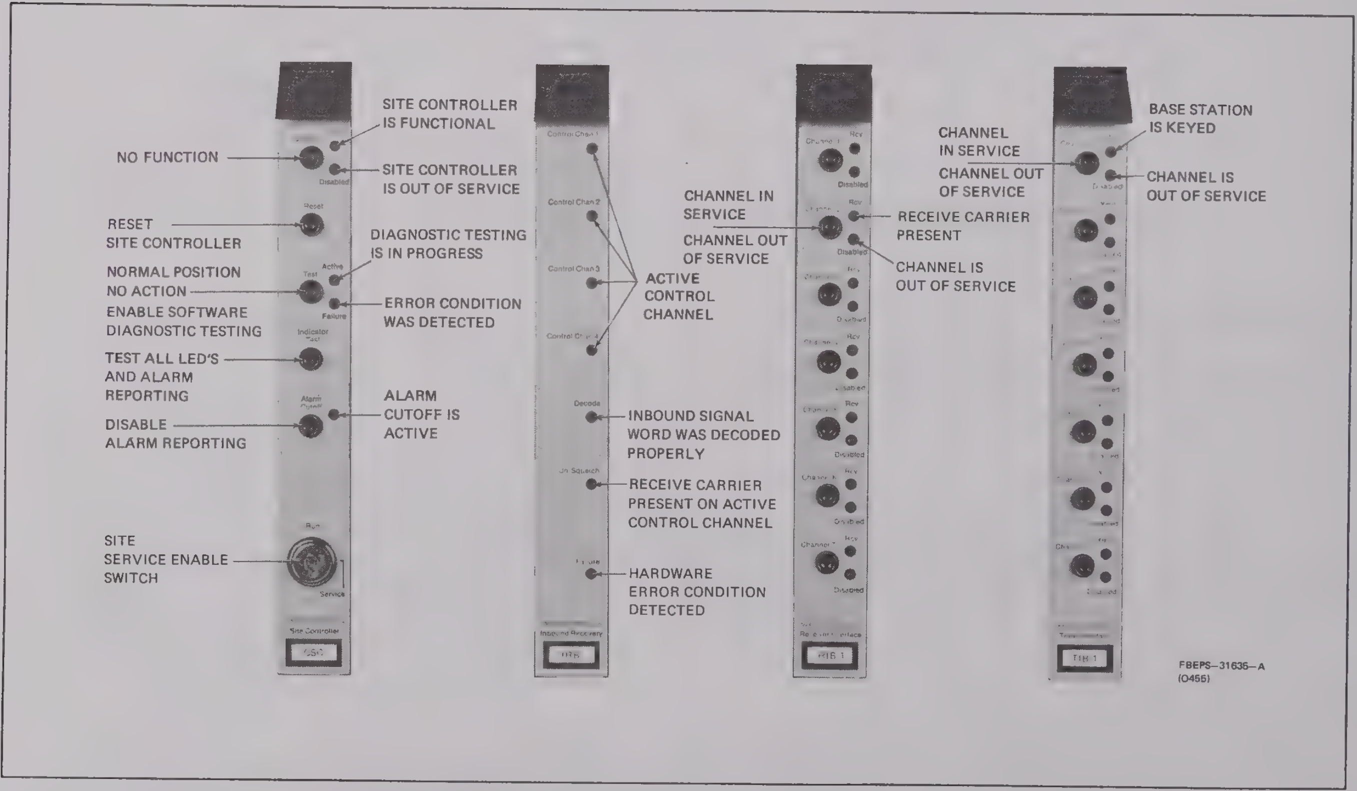

NO FUNCTION
SITE CONTROLLER IS FUNCTIONAL
SITE CONTROLLER IS OUT OF SERVICE
RESET SITE CONTROLLER
DIAGNOSTIC TESTING IS IN PROGRESS
NORMAL POSITION NO ACTION
ENABLE SOFTWARE DIAGNOSTIC TESTING
ERROR CONDITION WAS DETECTED
TEST ALL LED'S AND ALARM REPORTING
ALARM CUTOFF IS ACTIVE
DISABLE ALARM REPORTING
SITE SERVICE ENABLE SWITCH
Disabled
Reset
Active
Test
Failure
Indicator Test
Run
Service
Site Controller
CSC
Control Chan 1
Control Chan 2
Control Chan 3
Decode
Inbound Recovery
IRB
ACTIVE CONTROL CHANNEL
INBOUND SIGNAL WORD WAS DECODED PROPERLY
RECEIVE CARRIER PRESENT ON ACTIVE CONTROL CHANNEL
HARDWARE ERROR CONDITION DETECTED
CHANNEL IN SERVICE
CHANNEL OUT OF SERVICE
RECEIVE CARRIER PRESENT
CHANNEL IS OUT OF SERVICE
Rcv
RIB 1
CHANNEL IN SERVICE
CHANNEL OUT OF SERVICE
BASE STATION IS KEYED
CHANNEL IS OUT OF SERVICE
TIB 1
FBEPS—31636—A
(0455)

Figure 30. Module Controls and Indicators (CSC, IRB, RIB, TIB)

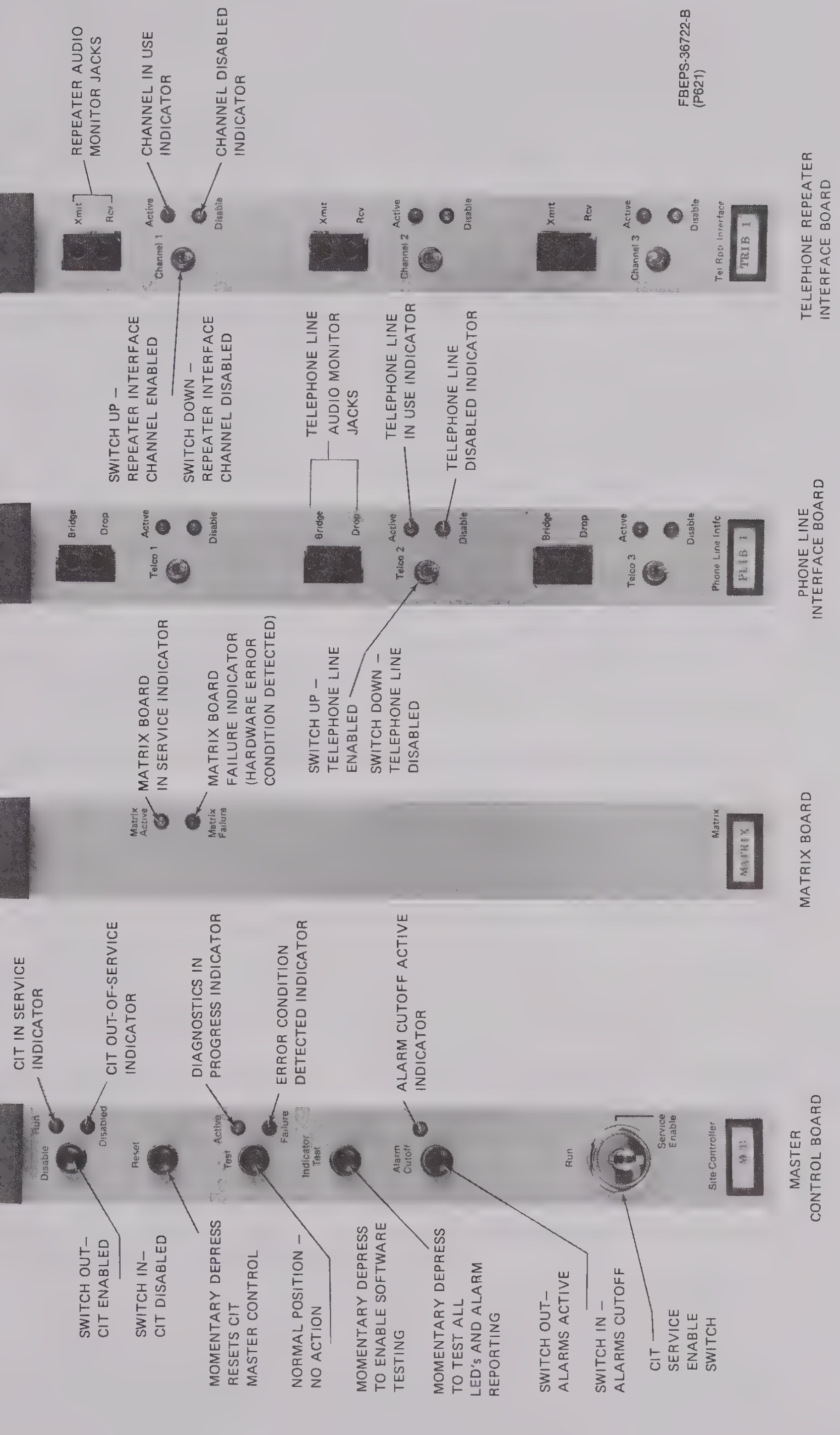

MASTER CONTROL BOARD
SWITCH OUT– CIT ENABLED
SWITCH IN– CIT DISABLED
CIT IN SERVICE INDICATOR
CIT OUT-OF-SERVICE INDICATOR
MOMENTARY DEPRESS RESETS CIT MASTER CONTROL
DIAGNOSTICS IN PROGRESS INDICATOR
ERROR CONDITION DETECTED INDICATOR
NORMAL POSITION – NO ACTION
MOMENTARY DEPRESS TO ENABLE SOFTWARE TESTING
MOMENTARY DEPRESS TO TEST ALL LED's AND ALARM REPORTING
ALARM CUTOFF ACTIVE INDICATOR
SWITCH OUT– ALARMS ACTIVE
SWITCH IN – ALARMS CUTOFF
CIT SERVICE ENABLE SWITCH
Disable
Run
Disabled
Reset
Active
Test
Failure
Indicator Test
Alarm Cutoff
Run
Service Enable
Site Controller
MATRIX BOARD
MATRIX BOARD IN SERVICE INDICATOR
MATRIX BOARD FAILURE INDICATOR (HARDWARE ERROR CONDITION DETECTED)
Matrix Active
Matrix Failure
Matrix
MATRIX
PHONE LINE INTERFACE BOARD
SWITCH UP – TELEPHONE LINE ENABLED
SWITCH DOWN – TELEPHONE LINE DISABLED
TELEPHONE LINE AUDIO MONITOR JACKS
TELEPHONE LINE IN USE INDICATOR
TELEPHONE LINE DISABLED INDICATOR
Bridge
Drop
Telco 1
Telco 2
Telco 3
Active
Disable
Phone Line Intfc
PLIB 1
TELEPHONE REPEATER INTERFACE BOARD
SWITCH UP – REPEATER INTERFACE CHANNEL ENABLED
SWITCH DOWN – REPEATER INTERFACE CHANNEL DISABLED
REPEATER AUDIO MONITOR JACKS
CHANNEL IN USE INDICATOR
CHANNEL DISABLED INDICATOR
Xmit
Rcv
Channel 1
Channel 2
Channel 3
Active
Disable
Tel Rptr Interface
TRIB 1
FBEPS-36722-B (P621)

Figure 31. Module Controls and Indicators (MCB, MATRIX, PLIB, TRIB)

the CSC, RSC or TSC module produce a test error. These indications include LED displays, printed error messages and system reversion to FAILSOFT operation.

NOTE

> The central controller modules test the RAM integrated circuits first and the EPROM integrated circuits second. If an error condition is detected during the RAM test, the EPROM test is not performed.

CSC, RSC, or TSC Module RAM or EPROM Test Failure

The system manager does not receive an indication that the RAM or EPROM test failed if the ALARM CUTOFF button on the respective module (RSC or TSC) front panel is depressed when the test is initiated. The error condition is disregarded and normal program execution is attempted.

If the ALARM CUTOFF button is not depressed and a terminal is not connected to the respective module RS–232–C port, the FAILURE LED is lit continuously, the ACTIVE LED flashes, and the system reverts to FAILSOFT operation.

After a test failure is indicated, the system manager may instruct the central controller to disregard the error condition by depressing the ALARM CUTOFF button. The central controller responds by printing ERROR ACKNOWLEDGED at the terminal, if it is connected, and attempts normal program execution.

If the ALARM CUTOFF button is not depressed and a terminal is connected to the respective module RS–232–C port, the FAILURE LED is lit continuously, the RAM or EPROM error condition is printed at the terminal, and the system reverts to FAILSOFT operation.

The RESTART function provides for a total reinitialization of the system. The program automatically restarts when one of the following conditions is detected:

- RAM failure on CSC module
- EPROM failure on CSC module
- Master RESET via module front panel or terminal
- Software detected error
- Power failure
- `(ESC)*` entered from system manager terminal

Table 4. Restart Operational Sequences

Module Restarted	Sequence
CSC Module	• RSC Module Resets • TSC Module Resets • All Variables Initialized at CSC Module
RSC Module	• RSC Module Resets • Channel Status Updated at CSC Module • All Current Calls are Terminated • Control Channel Reassigned
TSC Module	• TSC Module Resets • Channel Status Updated at CSC Module • All Current Calls are Terminated • Control Channel Reassigned

Table 4 summarizes system operational sequences during the RESTART function.

13. TIME COMMAND

(Refer to Figure 32.)

The TIME command allows the system manager to query and/or modify the time set on the system clock. An example of how to use the TIME command is shown in NO TAG. The time is in 24–hour format:

`HH:MM:SS` where `HH` = hour (00–23)
`MM` = minutes (00–59)
`SS` = seconds (00–59)

```
GRD> TIME(CR)
CURRENT TIME (HH:MM:SS) IS  9:39:14
CORRECT (Y/N): N(CR)
CHANGE TIME (HH:MM::SS) TO: 9:34:15(CR)
CURRENT TIME (HH:MM:SS) IS  9:34:15
CORRECT (Y/N): Y(CR)

GRD>
```

Figure 32. TIME Command Example

14. VER COMMAND

(Refer to Figure 33.)

The VER command displays current version numbers of various system attributes. These include the code plug, CSC, and MCB. An example of how to use the VER command is provided in Figure 33.

```
GRD> VER(CR)
CP VERSION  04
CSC VERSION V31.1
MCB VERSION 0382

GRD>
```

Figure 33. VER Command Example

15. EMRG COMMAND

(Refer to Figure 34.)

The EMRG command permits the system manager to examine and modify parameters associated with emergency call handling. Refer to Table 5.

Note that this command and associated features are not available with *Privacy Plus–Enhanced* models unless equipped with the D554 *ShareNet* Upgrade Option. Without the option, however, emergency call requests may processed by converting them to regular dispatch calls.

With *SmartWorks* models, this command is not provided unless equipped with a D407 upgrade option. However, emergency call processing is supported with the following fixed attributes.

- Top of Queue
- No Reserved Repeaters
- 30–Second Hold Time

15.1 HELP COMMAND

This command lists the EMRG commands available for the logon ID. An account is either excluded from the EMRG command or permitted all commands.

Table 5. EMRG Command Summary

Command	Paragraph	Description
Help	15.1	Lists available EMRG commands.
Top	15.2	Emergency calls assigned to next available channel.
Preempt	15.3	Emergency call preempts current lowest priority call.
Reserve	15.4	Channels are reserved for emergency traffic.
Hold	15.5	Extends message trunked timeout (PARM paragraph 7.) for emergency calls.
MULY	15.6	Emergency calls sent to all members of announcement talkgroup.
MULN	15.7	Emergency calls sent only to addressed unit.

```
 GRD> EMRG(CR)

EMRG> HELP(CR)

AVAILABLE COMMANDS FOR YOUR LOGON ID ARE:
     QUIT
     HOLD
     RESERVE
     LIST
     TOP
     PREEMPT

EMRG> LIST(CR)
 HOLD T.O. =  :32
 NUMBER OF RESERVED REPEATERS =  0
 EMERGENCY CALL HANDLING =  TOP OF QUEUE
 MULTI GROUP EMERGENCY CALL =  NO

EMRG> HOLD 0:45(CR)

EMRG> RESERVE 1(CR)

EMRG> PREEMPT(CR)

EMRG> MULY(CR)

EMRG> LIST(CR)
 HOLD T.O. =  :45
 NUMBER OF RESERVED REPEATERS =  1
 EMERGENCY CALL HANDLING =  RUTHLESS PRE-EMPTION
 MULTI GROUP EMERGENCY CALL = YES

EMRG> Q(CR)

 GRD>
```

Figure 34. EMRG Command Example

15.2 TOP COMMAND

This command selects the Top–of–queue method for emergency–call channel assignment when no channel is available. Emergency call requests are put on the emergency queue and are processed as soon as a channel becomes available. Also, to free up a channel quicker, all calls (except phone calls and emergency calls) become transmission trunked (no repeater hang time).

15.3 PREEMPT COMMAND

This command selects the Preemptive method for emergency–call channel assignment when no channel is available. The lowest priority call is terminated (phone calls and emergency calls are not preempted). The channel assigned to the terminated call is re–assigned for an emergency call. If no call can be terminated, the Top–of–Queue method is used. It should be noted that the emergency call is assigned to the same channel as an active call and that voice contention may occur.

15.4 RESERVE nn COMMAND

Reserves **nn** channels for emergency–ONLY traffic. The valid range for **nn** is 0 to 18, independent of the number of channels in the system. However, the maximum number of channels reserved at any time equals the number of useable channels minus 2 (e.g.; for a 10–channel system, the maximum number of reserved channels is 8 (when all channels are useable).

15.5 HOLD MM:SS COMMAND

Changes the extended repeater hold time to the value entered (where MM = minutes and SS = seconds). The range for this value is 00:00 to 25:24.

15.6 LIST COMMAND

This command lists the emergency call parameters.

15.7 MULTIGROUP EMERGENCY CALL YES (MULY) COMMAND

The MULY command turns on MultiGroup Emergency Calls; all units in the same announcement talkgroup receive an Emergency Call made in their announcement talkgroup.

15.8 MULTIGROUP EMERGENCY CALL NO (MULN) COMMAND

The MULN command turns off MultiGroup Emergency Calls.

15.9 QUIT COMMAND

The QUIT command exits from EMRG. Control is returned to the GRD > prompt.

16. MGC COMMAND

(Refer to Figure 35.)

The MGC command permits the system manager to examine and modify parameters associated with multi–group calls.

MGC Command Summary

Command	Paragraph	Description
Help	16.1	Lists available MGC commands.
Int	16.2	Active dispatch calls are interrupted for multigroup calls.
Wait	16.3	Multigroup calls wait until end of dispatch calls for assignment.
Stat	16.4	List multigroup call processing status.
Quit	16.5	Exits to GUARDIAN GRD > prompt.

```
 GRD> MGC(CR)

 MGC> HELP(CR)

AVAILABLE COMMANDS FOR YOUR LOGON ID ARE:
     QUIT
     STAT
     INT
     WAIT

 MGC> STAT(CR)
MULTI-GROUP MODE = WAIT

 MGC> INT(CR)
MULTI-GROUP MODE = INTERRUPT

 MGC> Q(CR)

 GRD>
```

Figure 35. MGC Command Example

16.1 HELP COMMAND

This command lists the MGC commands available for the logon ID. An account is either excluded from the MGC command or permitted all commands.

16.2 INT COMMAND

Selects the interrupt method for handling a multigroup call channel assignment when talk group calls are active in the multigroup talk group fleet. All active dispatch calls in the multigroup talk group fleet are terminated and the multigroup call is started on the first available channel.

16.3 WAIT COMMAND

Selects the wait method for handling a multigroup call channel assignment when talk group calls are active in the multigroup talk group fleet. All active dispatch calls in the multigroup talk group fleet are transmission trunked and the multigroup call waits until all dispatch calls have ended before it is assigned.

16.4 STAT COMMAND

This command lists the multigroup call processing status.

16.5 QUIT COMMAND

The QUIT command exits from MGC. Control is returned to the GRD > prompt.

17. DVP COMMAND

(Refer to Figure 36.)

> **NOTE**
>
> This command is available only if the repeaters have been marked as DVP capable in the codeplug.

The DVP command permits the system manager to examine and modify parameters associated with digital voice privacy (secure–capable operations).

DVP Command Summary

Command	Paragraph	Description
Help	17.1	Lists available DVP commands.
Interconnect	17.2	Secure–capable units steered to available secure repeater.
Upgrade	17.3	Allows normal–to–secure call upgrade.
List	17.4	Lists status of DVP settings.
Quit	17.5	Exits to GUARDIAN GRD > prompt.

```
 GRD> DVP(CR)

 DVP> HELP(CR)

AVAILABLE COMMANDS FOR YOUR LOGON ID ARE:
     QUIT
     INTERCONNECT
     UPGRADE
     LIST

 DVP> LIST(CR)
INTERCONNECT CALLS ALWAYS STEERED TO SECURE REPEATERS
CALL UPGRADES PERMITTED

 DVP> INTERCONNECT(CR)
INTERCONNECT CALLS ALWAYS STEERED TO SECURE REPEATERS
REMAIN STEERED (Y/N)? N(CR)

 DVP> UPGRADE(CR)
CALL UPGRADES PERMITTED
REMAIN UPGRADABLE (Y/N)? N(CR)

 DVP> LIST(CR)
INTERCONNECT CALLS NOT STEERED TO SECURE REPEATERS
CALL UPGRADES NOT PERMITTED

 DVP> Q(CR)

 GRD>
```

Figure 36. DVP Command Example

17.1 HELP COMMAND

This command lists the DVP commands available for the logon ID. An account is either excluded from the DVP command or permitted all commands.

17.2 INTERCONNECT COMMAND

This command permits the user to select steering of all secure–capable units to secure repeaters for interconnect calls. This is possible only if there are secure repeaters available. The user is notified of the interconnect call steering status and then prompted to allow change of the status.

17.3 UPGRADE COMMAND

This command permits the user to allow or disallow call upgrades (normal to secure), with the exception of emergency calls, while the call is in progress. The user is notified of upgrade feature status and prompted to allow change of the status.

17.4 LIST COMMAND

This command lists the secure unit call processing status.

17.5 QUIT COMMAND

The QUIT command exits from DVP. Control is returned to the GRD > prompt.

18. DATA COMMAND

(Refer to Figure 37.)

NOTE

This command is only available if the repeaters have been marked Data capable in the codeplug.

The main purpose of this command is to inform the Central Site Controller (CSC) if the Default Data Channels should be assigned during the Reduced mode of Data operation. The Reduced Data mode is entered when communications are lost between the Trunked Central Controller (TCC) and the Trunked Data Controller (TDC). The Data system remains in Reduced mode until communications have been restored between the TCC and TDC.

The Default Data channels are a subset of the normal data channels and are automatically assigned for data upon entering the Reduced mode if indicated to do so by the System Manager through the use of this command. The DATA command also reports the current Data mode (Full or Reduced Operation) and the Default Data channels.

DATA Command Summary

Command	Paragraph	Description
Stats	18.1	Reports data mode and controls assignment of default data channels during reduced data mode.
Quit	18.2	Exits to GUARDIAN GRD > prompt.

18.1 STATS COMMAND

The STATS subcommand is used to show the current status of the Data system and, for the MASTER and CONTROL logon IDs, give the user the opportunity to change whether or not the Default Data channels are assigned during the Reduced Data mode. It first informs the user of the current Data mode, Full or Reduced Operation. It then lists all of the Default Data channels, even if they are disabled or malfunctioned. The user is then informed if the system is assigning the Default Data channels when in the Reduced Data mode, and (for the MASTER and CONTROL logon IDs) allows the user to change this state.

```
 GRD> DATA(CR)

DATA> STATS(CR)
 CURRENT DATA MODE: FULL OPERATION
 DEFAULT DATA CHANNELS:  6, 7
 ASSIGNING DEFAULT DATA CHANNELS WHEN IN REDUCED DATA MODE
 CONTINUE TO ASSIGN (Y/N)? N(CR) ☜ ------------------- This line does not appear for the SYSTEM logon ID

DATA> STATS(CR

 CURRENT DATA MODE: REDUCED OPERATION
 DEFAULT DATA CHANNELS:  6, 7
 NOT ASSIGNING CHANNELS WHEN IN REDUCED MODE
 CHANGE TO ASSIGN (Y/N)? Y(CR) ☜ -------------------- This line does not appear for the SYSTEM logon ID

DATA> Q(CR)

 GRD>
```

Figure 37. DATA Command Example

It is important for the user to realize that if the system is automatically assigning Default Data channels when the Data system enters the Reduced mode, those channels will remain assigned for data until we exit the Reduced mode and the TDC has informed the CSC to de–assign those channels by sending an End–Of–Call ISW for each Default Data channel.

IMPORTANT

The Default Data channels should not be used for voice traffic until the Reduced Data mode is ended and the TDC informs the CSC to de–assign those channels. This is because the TDC is not aware of which channels are being used for voice traffic and immediately takes control of all Default Data channels upon entering the Reduced Data mode and may immediately begin to transmit data on those channels.

Normally, the system is set up by the System Manager so that Default Data channels are assigned when in the Reduced Data mode. However, if the Data system is removed from the Trunked system, or is just not in operation on the Trunked system, then it may not be desired to assign the Default Data channels. This would, in turn, allow for the Default Data channels to be used for voice traffic while in the Reduced Data mode.

If the user changes whether or not the Data system should assign Default Data channels when in Reduced Data mode while the Data system is currently in the Reduced mode of operation, a TDC–TCI link disable command will be issued from the GUARDIAN program. This will cause the current Default Data channel assignments to coincide with what the user has just specified.

For example, assume the Data system is currently in the Reduced mode and all Default Data channels are assigned for data calls as previously specified through the STATS command. The System Manager then enters the STATS command and informs the CSC not to assign the Default Data channels when in the Reduced Data mode. Thirty (30) seconds later, the CSC will de–assign all data calls active on the Default Data channels. The 30–second delay is present to give the Data Network Control Processor (NCP) time to clean up any active data calls.

In the reverse case, assume the Data system is currently in the Reduced mode but no Default Data channels are assigned for data calls, as previously instructed by the System Manager through the STATS command (the Default Data channels could be assigned to voice traffic in this case). The System Manager then enters the STATS command and informs the CSC to assign the Default Data channels when in the Reduced mode. The Data system will then immediately de–assign any voice traffic active on the Default Data channels (Emergency calls will be transmission trunked). All Default Data channels will then be assigned to data calls and voice traffic will not be allowed on these channels.

18.2 QUIT COMMAND

The QUIT subcommand is used to terminate the DATA command user interface routine and return control to the GRD > prompt.

19. SITE COMMANDS

(Refer to Figure 38 and Figure 39.)

The SITE command permits the systems manager to perform certain operations on specific sites from a remote site SMT or a master site SMT.

SITE Command Summary

Command	Paragraph	Description
Critical	19.3	Sets a site to Critical.
Disable	19.2	Disables a site from the SMT.
Enable	19.2	Enables a site from the SMT.
Help	19.1	Lists valid SITE commands.
Initialize	19.4	Clears major & minor alarms at a site.
Non–critical	19.3	Sets a site to non–critical.
Quit	19.6	Exits to GUARDIAN prompt GRD >.
Status	19.5	Displays status of a site or group of sites.

All SITE commands from the Master SMT accept site specifications in the form of **nn** (specifies a single site), **nn–mm** (specifies a range of sites), or **A** (specifies all sites, 1–10). Only the Initialize and Status commands are accepted without a site number. Entering Initialize (without a site number) from the Master SMT clears the major and minor alarms at the Master site only. Entering Status (without a site number) from the Master SMT will give the status of the Master site only.

Commands entered from a Remote SMT can access only information about that remote site. Therefore, none of the commands will accept site number specifications; commands entered with a site number are rejected.

19.1 HELP COMMAND

Typing 'HELP' at the SITE > prompt lists the valid SITE commands.

SITE Command Syntax

Command	Description
E A	Enable ALL sites.
E nn	Enable site nn.
E nn–mm	Enable sites nn through mm.
D A	Disable ALL sites.
D nn	Disable site nn.
D nn–mm	Disable sites nn through mm.
C A	Set ALL sites to Critical.
C nn	Set site nn to Critical.
C nn–mm	Set sites nn through mm to Critical.
N A	Set ALL sites to Non–critical.
N nn	Set site nn to Non–critical.
N nn–mm	Set sites nn through mm to Non–critical.
I	Clear Major and Minor Alarms at particular site.
I A	Clear Major and Minor Alarms at ALL sites.
I nn	Clear Major and Minor Alarms at site nn.
I nn–mm	Clear Major and Minor Alarms at sites nn through mm.

19.2 ENABLE AND DISABLE COMMANDS

The ENABLE and DISABLE commands allow a specific site contained in the AMSS system to be enabled and disabled via the SMT, in addition to the current ACB pushbutton method.

- A site is enabled if SMT, DCB, and Remote are all enabled.
- A site is disabled if SMT, DCB, or Remote is disabled.

19.3 CRITICAL AND NON–CRITICAL COMMANDS

The CRITICAL and NON–CRITICAL commands allow the system manager to declare a site critical or non–critical from the SMT (Remote SMT or Master SMT).

- A site is critical if made critical from the Master SMT or the Remote SMT.
- A site is non–critical if made non–critical from the Master SMT or the Remote SMT.

NOTE

The Master and Remote SMTs have equal priority when it comes to setting a site to be enabled or disabled or setting a site to be critical or non–critical. The latest setting from either determines the status.

19.4 INITIALIZE COMMAND

The INITIALIZE command allows the system manager to clear site major and minor alarms via the SMT (Remote SMT and Master SMT).

19.5 STATUS COMMAND

(Refer to Table 6.)

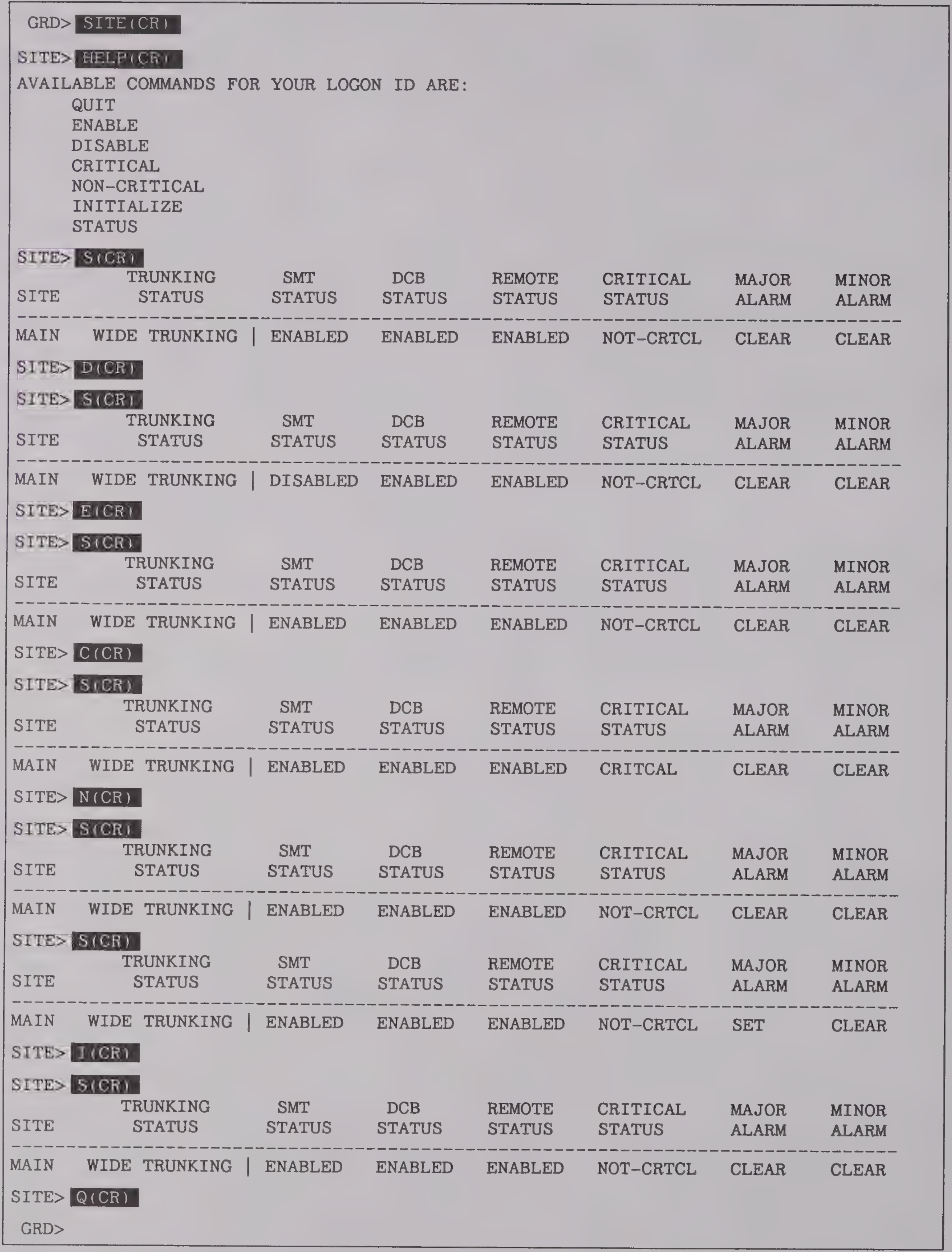
The STATUS command allows the system manager the ability to poll the status of the sites of the system via the SMT. From the Master SMT, the status of 1) a specific site (Status **nn**), 2) a range of sites (Status **nn–mm**), 3) all sites (Status **A**), or 4) the Master site only (Status) may be requested. From a Remote SMT, only the status of that particular remote (Status) may be requested.

Table 6. Explanation of Status Display

Heading/Display	Description
`SITE`	Site Status
`MAIN`	(See note).
`BACKUP`	(See note).
`#`	Site number (Master SMT inquiry).
`TRUNKING STATUS`	Master and Remote
`LOCAL TRUNKING`	System is trunking on local channels, wide–area channels are installed but not operational.
`WIDE TRUNKING`	System is trunking on wide–area channels, local channels are installed but not operational.
`TRUNKING`	System is trunking on wide–area and (if local channels are installed and operational) local channels.
`SITE FAILSOFT`	Site is in failsoft and its audio has been disconnected from the system.
`WIDE FAILSOFT`	The system is in wide–area failsoft.
`RECOVERING`	Minimum Failsoft Timer activated. When timer expires and all conditions for trunking have been met, the system will exit failsoft.
`NO MODEM`	DCB detects modem not present (based on modem DTR signal), the site is assumed not to be installed.
`TRUNKING STATUS`	Master SMT only
`IDLE`	The Master is idle (as opposed to Active)
`CAUSING FAILSOFT`	Indicates the site causing the system to be in failsoft.
`ISOLATED`	When a site is Non–Critical and the data link to that site is down, the status of this site cannot be determined. A site status of `SITE FAILSOFT` or `LOCAL TRUNKING` cannot be determined since local channel status (if local channels are even Installed) is unknown due to the failed link. Therefore, site status is labeled `ISOLATED`.
`SMT STATUS`	Site Status entered at SMT.
`ENABLED`	Site is enabled.
`DISABLED`	Site is disabled.

Table 6. Explanation of Status Display (Cont'd.)

`DCB STATUS`	Site Status entered at DCB via ACB pushbutton.
`REMOTE STATUS`	Site Status entered at remote CSC via ACB pushbutton.
`ENABLED` `DISABLED`	Site is enabled. Site is disabled.
`CRITICAL STATUS`	Critical Site information
`CRITICAL` `NON-CRITICAL`	Site is designated as a Critical Site. Site is designated as a Non-Critical Site.
`MAJOR ALARM`	Major Alarm Status
`CLEAR` `SET`	Site has Major Alarm cleared. Site has Major Alarm set.
`MINOR ALARM`	Minor Alarm Status
`CLEAR` `SET`	Site has Minor Alarm cleared. Site has Minor Alarm set.
Note: When conducting a status inquiry from a Remote SMT about a Remote site or inquiring about the status of the Master site, the `SITE` column will display whether the system is operating on a `MAIN` or `BACKUP` system. This refers only to Redundant Systems. If the system is not a Redundant System, the `SITE` column will display `MAIN` (default).	



```
 GRD> SITE(CR)

SITE> HELP(CR)
AVAILABLE COMMANDS FOR YOUR LOGON ID ARE:
     QUIT
     ENABLE
     DISABLE
     CRITICAL
     NON-CRITICAL
     INITIALIZE
     STATUS

SITE> S(CR)
          TRUNKING       SMT       DCB       REMOTE    CRITICAL    MAJOR    MINOR
SITE       STATUS        STATUS    STATUS    STATUS    STATUS      ALARM    ALARM
-----------------------------------------------------------------------------------
MAIN   WIDE TRUNKING | ENABLED    ENABLED   ENABLED   NOT-CRTCL    CLEAR    CLEAR

SITE> D(CR)

SITE> S(CR)
          TRUNKING       SMT       DCB       REMOTE    CRITICAL    MAJOR    MINOR
SITE       STATUS        STATUS    STATUS    STATUS    STATUS      ALARM    ALARM
-----------------------------------------------------------------------------------
MAIN   WIDE TRUNKING | DISABLED   ENABLED   ENABLED   NOT-CRTCL    CLEAR    CLEAR

SITE> E(CR)

SITE> S(CR)
          TRUNKING       SMT       DCB       REMOTE    CRITICAL    MAJOR    MINOR
SITE       STATUS        STATUS    STATUS    STATUS    STATUS      ALARM    ALARM
-----------------------------------------------------------------------------------
MAIN   WIDE TRUNKING | ENABLED    ENABLED   ENABLED   NOT-CRTCL    CLEAR    CLEAR

SITE> C(CR)

SITE> S(CR)
          TRUNKING       SMT       DCB       REMOTE    CRITICAL    MAJOR    MINOR
SITE       STATUS        STATUS    STATUS    STATUS    STATUS      ALARM    ALARM
-----------------------------------------------------------------------------------
MAIN   WIDE TRUNKING | ENABLED    ENABLED   ENABLED   CRITCAL      CLEAR    CLEAR

SITE> N(CR)

SITE> S(CR)
          TRUNKING       SMT       DCB       REMOTE    CRITICAL    MAJOR    MINOR
SITE       STATUS        STATUS    STATUS    STATUS    STATUS      ALARM    ALARM
-----------------------------------------------------------------------------------
MAIN   WIDE TRUNKING | ENABLED    ENABLED   ENABLED   NOT-CRTCL    CLEAR    CLEAR

SITE> S(CR)
          TRUNKING       SMT       DCB       REMOTE    CRITICAL    MAJOR    MINOR
SITE       STATUS        STATUS    STATUS    STATUS    STATUS      ALARM    ALARM
-----------------------------------------------------------------------------------
MAIN   WIDE TRUNKING | ENABLED    ENABLED   ENABLED   NOT-CRTCL    SET      CLEAR

SITE> I(CR)

SITE> S(CR)
          TRUNKING       SMT       DCB       REMOTE    CRITICAL    MAJOR    MINOR
SITE       STATUS        STATUS    STATUS    STATUS    STATUS      ALARM    ALARM
-----------------------------------------------------------------------------------
MAIN   WIDE TRUNKING | ENABLED    ENABLED   ENABLED   NOT-CRTCL    CLEAR    CLEAR

SITE> Q(CR)

 GRD>
```

Figure 38. SITE Command Example from an AMSS Remote SMT

```
GRD> SITE(CR)

SITE> HELP(CR)
AVAILABLE COMMANDS FOR YOUR LOGON ID ARE:
     QUIT
     ENABLE
     DISABLE
     CRITICAL
     NON-CRITICAL
     INITIALIZE
     STATUS

SITE> S(CR)
          TRUNKING      SMT       DCB      REMOTE    CRITICAL    MAJOR    MINOR
SITE       STATUS      STATUS    STATUS    STATUS    STATUS      ALARM    ALARM
--------------------------------------------------------------------------------
MAIN      TRUNKING   |                                           CLEAR    CLEAR

SITE> D 4(CR)

SITE> S 4(CR)
          TRUNKING      SMT       DCB      REMOTE    CRITICAL    MAJOR    MINOR
SITE       STATUS      STATUS    STATUS    STATUS    STATUS      ALARM    ALARM
--------------------------------------------------------------------------------
  4    SITE FAILSOFT | DISABLED  ENABLED   ENABLED   NOT-CRTCL   CLEAR    CLEAR

SITE> D 7-10(CR)

SITE> S A(CR)
          TRUNKING      SMT       DCB      REMOTE    CRITICAL    MAJOR    MINOR
SITE       STATUS      STATUS    STATUS    STATUS    STATUS      ALARM    ALARM
--------------------------------------------------------------------------------
MAIN      TRUNKING   |                                           CLEAR    CLEAR
  1       TRUNKING   | ENABLED   ENABLED   ENABLED   NOT-CRTCL   CLEAR    CLEAR
  2       TRUNKING   | ENABLED   ENABLED   ENABLED   NOT-CRTCL   CLEAR    CLEAR
  3       TRUNKING   | ENABLED   ENABLED   ENABLED   NOT-CRTCL   CLEAR    CLEAR
  4    SITE FAILSOFT | DISABLED  ENABLED   ENABLED   NOT-CRTCL   CLEAR    CLEAR
  5       TRUNKING   | ENABLED   ENABLED   ENABLED   NOT-CRTCL   CLEAR    CLEAR
  6       TRUNKING   | ENABLED   ENABLED   ENABLED   NOT-CRTCL   CLEAR    CLEAR
  7    SITE FAILSOFT | DISABLED  ENABLED   ENABLED   NOT-CRTCL   CLEAR    CLEAR
  8    SITE FAILSOFT | DISABLED  ENABLED   ENABLED   NOT-CRTCL   CLEAR    CLEAR
  9    SITE FAILSOFT | DISABLED  ENABLED   ENABLED   NOT-CRTCL   CLEAR    CLEAR
 10    SITE FAILSOFT | DISABLED  ENABLED   ENABLED   NOT-CRTCL   CLEAR    CLEAR

SITE> E A(CR)

SITE> S A(CR)
          TRUNKING      SMT       DCB      REMOTE    CRITICAL    MAJOR    MINOR
SITE       STATUS      STATUS    STATUS    STATUS    STATUS      ALARM    ALARM
--------------------------------------------------------------------------------
MAIN      TRUNKING   |                                           CLEAR    CLEAR
  1       TRUNKING   | ENABLED   ENABLED   ENABLED   NOT-CRTCL   CLEAR    CLEAR
  2       TRUNKING   | ENABLED   ENABLED   ENABLED   NOT-CRTCL   CLEAR    CLEAR
  3       TRUNKING   | ENABLED   ENABLED   ENABLED   NOT-CRTCL   CLEAR    CLEAR
  4       TRUNKING   | ENABLED   ENABLED   ENABLED   NOT-CRTCL   CLEAR    CLEAR
  5       TRUNKING   | ENABLED   ENABLED   ENABLED   NOT-CRTCL   CLEAR    CLEAR
  6       TRUNKING   | ENABLED   ENABLED   ENABLED   NOT-CRTCL   CLEAR    CLEAR
  7       TRUNKING   | ENABLED   ENABLED   ENABLED   NOT-CRTCL   CLEAR    CLEAR
  8       TRUNKING   | ENABLED   ENABLED   ENABLED   NOT-CRTCL   CLEAR    CLEAR
  9       TRUNKING   | ENABLED   ENABLED   ENABLED   NOT-CRTCL   CLEAR    CLEAR
 10       TRUNKING   | ENABLED   ENABLED   ENABLED   NOT-CRTCL   CLEAR    CLEAR

SITE>
```

Figure 39. SITE Command Example from an AMSS Master SMT (Sheet 1 of 4)

```
SITE> C(CR)
C COMMAND FORMAT IS:
C NN
C NN-MM
C A

SITE> C 9(CR)

SITE> S 9(CR)
         TRUNKING     SMT        DCB       REMOTE     CRITICAL     MAJOR    MINOR
SITE      STATUS      STATUS     STATUS    STATUS     STATUS       ALARM    ALARM
-----------------------------------------------------------------------------------
  9      TRUNKING   | ENABLED    ENABLED   ENABLED    CRITICAL     CLEAR    CLEAR
SITE> N 9(CR)

SITE> S 9(CR)
         TRUNKING     SMT        DCB       REMOTE     CRITICAL     MAJOR    MINOR
SITE      STATUS      STATUS     STATUS    STATUS     STATUS       ALARM    ALARM
-----------------------------------------------------------------------------------
  9      TRUNKING   | ENABLED    ENABLED   ENABLED    NOT-CRTCL    CLEAR    CLEAR
SITE> S A(CR)
         TRUNKING     SMT        DCB       REMOTE     CRITICAL     MAJOR    MINOR
SITE      STATUS      STATUS     STATUS    STATUS     STATUS       ALARM    ALARM
-----------------------------------------------------------------------------------
MAIN     FAILSOFT   |                                              SET      CLEAR
  1      FAILSOFT   | ENABLED    ENABLED   ENABLED    NOT-CRTCL    CLEAR    CLEAR
  2      FAILSOFT   | ENABLED    ENABLED   ENABLED    NOT-CRTCL    CLEAR    CLEAR
  3      FAILSOFT   | ENABLED    ENABLED   ENABLED    NOT-CRTCL    CLEAR    CLEAR
  4      FAILSOFT   | ENABLED    ENABLED   ENABLED    NOT-CRTCL    CLEAR    CLEAR
  5      FAILSOFT   | ENABLED    ENABLED   ENABLED    NOT-CRTCL    CLEAR    CLEAR
  6      FAILSOFT   | ENABLED    ENABLED   ENABLED    NOT-CRTCL    CLEAR    CLEAR
  7      FAILSOFT   | ENABLED    ENABLED   ENABLED    NOT-CRTCL    CLEAR    CLEAR
  8      FAILSOFT   | ENABLED    ENABLED   ENABLED    NOT-CRTCL    CLEAR    CLEAR
  9      FAILSOFT   | ENABLED    ENABLED   ENABLED    NOT-CRTCL    CLEAR    CLEAR
 10      FAILSOFT   | ENABLED    ENABLED   ENABLED    NOT-CRTCL    CLEAR    CLEAR
SITE> I(CR)

SITE> S(CR)
         TRUNKING     SMT        DCB       REMOTE     CRITICAL     MAJOR    MINOR
SITE      STATUS      STATUS     STATUS    STATUS     STATUS       ALARM    ALARM
-----------------------------------------------------------------------------------
MAIN    RECOVERING  |                                              SET      CLEAR
SITE> S A(CR)
         TRUNKING     SMT        DCB       REMOTE     CRITICAL     MAJOR    MINOR
SITE      STATUS      STATUS     STATUS    STATUS     STATUS       ALARM    ALARM
-----------------------------------------------------------------------------------
MAIN     TRUNKING   |                                              CLEAR    CLEAR
  1      TRUNKING   | ENABLED    ENABLED   ENABLED    NOT-CRTCL    CLEAR    CLEAR
  2      TRUNKING   | ENABLED    ENABLED   ENABLED    NOT-CRTCL    SET      CLEAR
  3      TRUNKING   | ENABLED    ENABLED   ENABLED    NOT-CRTCL    CLEAR    CLEAR
  4      TRUNKING   | ENABLED    ENABLED   ENABLED    NOT-CRTCL    CLEAR    CLEAR
  5      TRUNKING   | ENABLED    ENABLED   ENABLED    NOT-CRTCL    CLEAR    CLEAR
  6      TRUNKING   | ENABLED    ENABLED   ENABLED    NOT-CRTCL    CLEAR    CLEAR
  7      TRUNKING   | ENABLED    ENABLED   ENABLED    NOT-CRTCL    CLEAR    CLEAR
  8      TRUNKING   | ENABLED    ENABLED   ENABLED    NOT-CRTCL    CLEAR    CLEAR
  9      TRUNKING   | ENABLED    ENABLED   ENABLED    NOT-CRTCL    CLEAR    CLEAR
 10      TRUNKING   | ENABLED    ENABLED   ENABLED    NOT-CRTCL    CLEAR    CLEAR
```

Figure 39. SITE Command Example from an AMSS Master SMT (Sheet 2 of 4)

```
SITE> I 2(CR)

SITE> S 2(CR)
          TRUNKING       SMT        DCB        REMOTE     CRITICAL    MAJOR    MINOR
SITE       STATUS       STATUS     STATUS     STATUS     STATUS      ALARM    ALARM
--------------------------------------------------------------------------------------
  2       TRUNKING   |  ENABLED    ENABLED    ENABLED    NOT-CRTCL   CLEAR    CLEAR

SITE> S A(CR)
          TRUNKING       SMT        DCB        REMOTE     CRITICAL    MAJOR    MINOR
SITE       STATUS       STATUS     STATUS     STATUS     STATUS      ALARM    ALARM
--------------------------------------------------------------------------------------
MAIN      FAILSOFT   |                                               SET      CLEAR
  1       FAILSOFT   |  ENABLED    ENABLED    ENABLED    NOT-CRTCL   SET      CLEAR
  2       FAILSOFT   |  ENABLED    ENABLED    ENABLED    NOT-CRTCL   SET      CLEAR
  3       FAILSOFT   |  ENABLED    ENABLED    ENABLED    NOT-CRTCL   SET      CLEAR
  4       FAILSOFT   |  ENABLED    ENABLED    ENABLED    NOT-CRTCL   SET      CLEAR
  5       FAILSOFT   |  ENABLED    ENABLED    ENABLED    NOT-CRTCL   SET      CLEAR
  6       FAILSOFT   |  ENABLED    ENABLED    ENABLED    NOT-CRTCL   SET      CLEAR
  7       FAILSOFT   |  ENABLED    ENABLED    ENABLED    NOT-CRTCL   SET      CLEAR
  8       FAILSOFT   |  ENABLED    ENABLED    ENABLED    NOT-CRTCL   SET      CLEAR
  9       FAILSOFT   |  ENABLED    ENABLED    ENABLED    NOT-CRTCL   SET      CLEAR
 10       FAILSOFT   |  ENABLED    ENABLED    ENABLED    NOT-CRTCL   SET      CLEAR
SITE> I A(CR)

SITE> S A(CR)
          TRUNKING       SMT        DCB        REMOTE     CRITICAL    MAJOR    MINOR
SITE       STATUS       STATUS     STATUS     STATUS     STATUS      ALARM    ALARM
--------------------------------------------------------------------------------------
MAIN     RECOVERING  |                                               CLEAR    CLEAR
  1    WIDE FAILSOFT |  ENABLED    ENABLED    ENABLED    NOT-CRTCL   CLEAR    CLEAR
  2    WIDE FAILSOFT |  ENABLED    ENABLED    ENABLED    NOT-CRTCL   CLEAR    CLEAR
  3    WIDE FAILSOFT |  ENABLED    ENABLED    ENABLED    NOT-CRTCL   CLEAR    CLEAR
  4    WIDE FAILSOFT |  ENABLED    ENABLED    ENABLED    NOT-CRTCL   CLEAR    CLEAR
  5    WIDE FAILSOFT |  ENABLED    ENABLED    ENABLED    NOT-CRTCL   CLEAR    CLEAR
  6    WIDE FAILSOFT |  ENABLED    ENABLED    ENABLED    NOT-CRTCL   CLEAR    CLEAR
  7    WIDE FAILSOFT |  ENABLED    ENABLED    ENABLED    NOT-CRTCL   CLEAR    CLEAR
  8    WIDE FAILSOFT |  ENABLED    ENABLED    ENABLED    NOT-CRTCL   CLEAR    CLEAR
  9    WIDE FAILSOFT |  ENABLED    ENABLED    ENABLED    NOT-CRTCL   CLEAR    CLEAR
 10       TRUNKING   |  ENABLED    ENABLED    ENABLED    NOT-CRTCL   CLEAR    CLEAR

SITE> S A(CR)
          TRUNKING       SMT        DCB        REMOTE     CRITICAL    MAJOR    MINOR
SITE       STATUS       STATUS     STATUS     STATUS     STATUS      ALARM    ALARM
--------------------------------------------------------------------------------------
MAIN      TRUNKING   |                                               CLEAR    CLEAR
  1       TRUNKING   |  ENABLED    ENABLED    ENABLED    NOT-CRTCL   CLEAR    CLEAR
  2       TRUNKING   |  ENABLED    ENABLED    ENABLED    NOT-CRTCL   CLEAR    CLEAR
  3       TRUNKING   |  ENABLED    ENABLED    ENABLED    NOT-CRTCL   CLEAR    CLEAR
  4       TRUNKING   |  ENABLED    ENABLED    ENABLED    NOT-CRTCL   CLEAR    CLEAR
  5       TRUNKING   |  ENABLED    ENABLED    ENABLED    NOT-CRTCL   CLEAR    CLEAR
  6       TRUNKING   |  ENABLED    ENABLED    ENABLED    NOT-CRTCL   CLEAR    CLEAR
  7       TRUNKING   |  ENABLED    ENABLED    ENABLED    NOT-CRTCL   CLEAR    CLEAR
  8       TRUNKING   |  ENABLED    ENABLED    ENABLED    NOT-CRTCL   CLEAR    CLEAR
  9       TRUNKING   |  ENABLED    ENABLED    ENABLED    NOT-CRTCL   CLEAR    CLEAR
 10       TRUNKING   |  ENABLED    ENABLED    ENABLED    NOT-CRTCL   CLEAR    CLEAR

SITE>
```

Figure 39. SITE Command Example from an AMSS Master SMT (Sheet 3 of 4)

```
SITE> C 4-9(CR)

SITE> S A(CR)
          TRUNKING      SMT       DCB       REMOTE     CRITICAL    MAJOR    MINOR
SITE       STATUS      STATUS    STATUS     STATUS     STATUS      ALARM    ALARM
-------------------------------------------------------------------------------------
MAIN      TRUNKING   |                                             CLEAR    CLEAR
  1       TRUNKING   | ENABLED   ENABLED   ENABLED    NOT-CRTCL    CLEAR    CLEAR
  2       TRUNKING   | ENABLED   ENABLED   ENABLED    NOT-CRTCL    CLEAR    CLEAR
  3       TRUNKING   | ENABLED   ENABLED   ENABLED    NOT-CRTCL    CLEAR    CLEAR
  4       TRUNKING   | ENABLED   ENABLED   ENABLED    CRITICAL     CLEAR    CLEAR
  5       TRUNKING   | ENABLED   ENABLED   ENABLED    CRITICAL     CLEAR    CLEAR
  6       TRUNKING   | ENABLED   ENABLED   ENABLED    CRITICAL     CLEAR    CLEAR
  7       TRUNKING   | ENABLED   ENABLED   ENABLED    CRITICAL     CLEAR    CLEAR
  8       TRUNKING   | ENABLED   ENABLED   ENABLED    CRITICAL     CLEAR    CLEAR
  9       TRUNKING   | ENABLED   ENABLED   ENABLED    CRITICAL     CLEAR    CLEAR
 10       TRUNKING   | ENABLED   ENABLED   ENABLED    NOT-CRTCL    CLEAR    CLEAR

SITE> N 4-9(CR)

SITE> S A(CR)
          TRUNKING      SMT       DCB       REMOTE     CRITICAL    MAJOR    MINOR
SITE       STATUS      STATUS    STATUS     STATUS     STATUS      ALARM    ALARM
-------------------------------------------------------------------------------------
MAIN      TRUNKING   |                                             CLEAR    CLEAR
  1       TRUNKING   | ENABLED   ENABLED   ENABLED    NOT-CRTCL    CLEAR    CLEAR
  2       TRUNKING   | ENABLED   ENABLED   ENABLED    NOT-CRTCL    CLEAR    CLEAR
  3       TRUNKING   | ENABLED   ENABLED   ENABLED    NOT-CRTCL    CLEAR    CLEAR
  4       TRUNKING   | ENABLED   ENABLED   ENABLED    NOT-CRTCL    CLEAR    CLEAR
  5       TRUNKING   | ENABLED   ENABLED   ENABLED    NOT-CRTCL    CLEAR    CLEAR
  6       TRUNKING   | ENABLED   ENABLED   ENABLED    NOT-CRTCL    CLEAR    CLEAR
  7       TRUNKING   | ENABLED   ENABLED   ENABLED    NOT-CRTCL    CLEAR    CLEAR
  8       TRUNKING   | ENABLED   ENABLED   ENABLED    NOT-CRTCL    CLEAR    CLEAR
  9       TRUNKING   | ENABLED   ENABLED   ENABLED    NOT-CRTCL    CLEAR    CLEAR
 10       TRUNKING   | ENABLED   ENABLED   ENABLED    NOT-CRTCL    CLEAR    CLEAR

SITE> Q(CR)

 GRD>
```

Figure 39. SITE Command Example from an AMSS Master SMT (Sheet 4 of 4)

MOTOROLA INC.
Communications
Sector

TELEPHONE INTERCONNECT COMMANDS AND RESPONSES

1. INTRODUCTION

The user data base consists mainly of two types of records, talk group and individual. Each record specifies attributes for an individual or talk group telling how a unit may use the system.

The ID scheme now consists of Type I and Type II IDs. Following is a description of the new ID structure for the *Smartnet II* protocol.

Type I IDs

The ID scheme for Type I IDs in a *Smartnet II* system remains the same as Type I systems. That is, use of the hexadecimal fleet–subfleet–individual convention is continued. Individual IDs are referenced by a 3 digit hexadecimal fleet number, ranging from 000 to 77F, followed by a 3 digit hexadecimal individual number, ranging from 000 to FFE. Subfleets may also be referenced by the same fleet number followed by a 2–digit hexadecimal subfleet number, ranging from 00 to 0F. All the aforementioned ranges are dependent upon the size code.

When the subfleet ID is entered at the System Manager's Terminal, the subfleet portion must be preceded with an 'S' to distinguish it from the individual ID.

Examples

705	001	(fleet 705, individual 1)
10F	30F	(fleet 10F, individual 30F)
405	S01	(fleet 405, subfleet 1)
600	S0A	(fleet 600, subfleet A)

Type II IDs

The Type II ID is referenced with a 6 digit decimal number. This number is the same as the Type II land–to–mobile interconnect and Private Call II IDs.

Individual IDs must begin with a '7' followed by 5 decimal digits ranging from 00001 to 65534. These 5 digits are a direct decimal conversion of the 4 digit hexadecimal ID. Talk group IDs must begin with an '8' followed by 5 decimal digits ranging from 00001 to 04094. Once again, these 5 digits are a direct decimal conversion of the 3 digit hexadecimal talk group ID.

When a Type II ID is entered at the System Manager Terminal, it must be preceded by an 'I' or 'T', for individual or talk group, respectively. This is to distinguish Type I and Type II IDs.

Examples

I705001	(individual 5001)
I700235	(individual 235)
T800001	(talk group 1)
T800300	(talk group 300)

The following commands are available if the trunked system is equipped with interconnect. This means that the system was ordered with options D163 or D401 or the unit was upgraded in the field by adding Model T5188 or T5188 with D401 to the basic unit.

2. AUTH COMMANDS

The authorization command family provides the system manager with those commands necessary to build and modify memory tables containing unit IDs and talk group IDs authorized for interconnect call service. The various commands are summarized below.

Command	Paragraph	Description
Add	2.1	Add unit or talk group to list.
Tran	2.2	Define translation from Type I 4–digit access number to Type II 6–digit numbers.
Delete	2.3	Delete unit or talk group from list.
Edit	2.4	Edit unit or talk group record information.
List	2.5	Provide current unit or talk group list.
Status	2.6	Authorization list status .
Pdigit	2.7	Predigit dialing sequence.
Update	2.8	Move changes to permanent memory.
Reset	2.9	Clear all user, talk group, and billing data.
Msave	2.10	Saves MCB database.
Mload	2.11	Loads MCB database.
Quit	2.12	Exit to GUARDIAN prompt GRD >.

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2.1 ADD COMMAND

(Refer to Figure 1.)

The ADD command enters a new unit ID or talk group ID for Type II systems, or, a new fleet/individual or fleet/subfleet for Type I systems, to the authorization table. With Optioin D610, the message "INVALID ID (Roamer)" will be displayed if the new unit ID conflicts with the temporary ID pool. An explanation of the Figure 1 listing follows.

- ADD I757349 (Type II), 600 100 (Type I) – The unit ID is specified for Type II, with a space required between the ADD and the unit ID. The fleet/individual is specified for Type I. A space is required between the ADD and the fleet, and, between the fleet and the individual. The unit ID should appear on a label that is attached to the unit.
  - Half duplex – This feature applies to the individual user's radio. A typical dispatch radio is half duplex compatible.
  - Local limit level – The local call limit level specifies the maximum TELCO charge credit for a unit during a billing period. A user who exceeds the assigned call limit level is not allowed to make further calls until the c all limit level is increased. The actual dollar amount (0–$999.99) assigned to the four possible levels can be listed with the LTEL command. The dollar amount s were originally entered with the INIT command. The LTEL and INIT commands are part of the BILL command family.

```
 GRD> AUTH(CR)
AUTH> ADD I757349(CR)
 HALF DUPLEX (Y/N): Y(CR)
 ENTER LOCAL LIMIT LEVEL (1-4): 1(CR)
 ENTER AUTHORIZATION STATUS LEVEL (1-5): 2(CR)
 ENABLE 0+ DIALING (Y/N)? Y(CR)
 ENABLE 1+ DIALING (Y/N)? Y(CR)
 ENTER CUSTOMER GROUP: 103(CR)
    L-M ACCESS NUMBER IS 757349

AUTH> ADD 600 100(CR)
 HALF DUPLEX (Y/N): N(CR)
 ENTER LOCAL LIMIT LEVEL (1-4): 2(CR)
 ENTER AUTHORIZATION STATUS LEVEL (1-5): 2(CR)
 ENABLE 0+ DIALING (Y/N)? Y(CR)
 ENABLE 1+ DIALING (Y/N)? N(CR)
    L-M ACCESS NUMBER IS 052480

AUTH> ADD I757360*(CR)
 ENTER CUSTOMER GROUP: 104(CR)
    L-M ACCESS NUMBER IS 757360

AUTH> ADD T803587(CR)
 ENTER AUTHORIZATION STATUS LEVEL (1-5): 2(CR)
 ENTER CUSTOMER GROUP: 103(CR)
    L-M ACCESS NUMBER IS 803587

AUTH> ADD 600 801(CR)
 ENTER AUTHORIZATION STATUS LEVEL (1-5): 2(CR)
    L-M ACCESS NUMBER IS 949664

AUTH> Q(CR)
ACTIVE USER LIST

 GRD>
```

Figure 1. ADD Command Example

— Authorization status level – This parameter specifies the authorized TELCO exchange coverage area for that unit. The five possible levels are defined as follows:

1. No calls are allowed (monthly fixed AIRTIME charges are assigned).
2. Calls that are free in the local area code as well as calls to nearby area code(s) that are free.
   - 1+ dialing may need to be enabled if a 1 is required preceding the call.
   - Any type of 0+ calling is allowed if enabled.
   - 411, 911 and 800 calls are allowed.
3. Free and 'unit calls' to exchanges in the local area code or nearby area code(s) that have had exchange rate information entered into the system memory.
   - 1+ dialing may need to be enabled if a 1 is required preceding the call.
   - Any type of 0+ calling is allowed if enabled.
   - 411, 911 and 800 calls are allowed.
4. All exchanges in the local area code as well as all exchanges in any area code (s) specified nearby.
   - 1+ dialing may need to be enabled if a 1 is required preceding the call.
   - Any type of 0+ calling is allowed if enabled.
   - 411, 911 and 800 calls are allowed.
5. All exchanges in all area codes.
   - 1+ dialing may need to be enabled if a 1 is required preceding the call.
   - Any type of 0+ calling is allowed if enabled.
   - 411, 911 and 800 calls are allowed.

— 0+ refers to the TELCO credit card calls, i.e., 0–312–976–1212. The LEXC command can be used to list out the TELCO exchange rates for the system area code plus those that are in nearby codes. The exchange rates were originally entered with the INIT command. The LEXC and INIT commands are part of the BILL command family.

— Customer Group –The customer group will be used to summarize call information for individual u nits and talk groups into customer groups. The customer number may be any value between 1 and FFE. It may be a fleet number if that is convenient, or other numbers can be used to create super groups or sub groups as required by the system manger. This number need not be added for Type I talk groups, since the customer group is automatically set to the fleet entered.

— L–M Access Number – The L–M (land–to–mobile) access number for Type II units is the 6 digit extension that is dialed by the land party when calling that party's radio. The access number is constant for each unit and may be calculated by taking the number 7 and appending the unit hex ID number converted to a 5 position decimal (leading zeros are significant). Type I units use the 6–digit decimal ID calculated by converting the 4–digit hexadecimal equivalent of size code prefix, fleet, subfleet, and individual IDs.

- ADD I757360* –Entering the * character after the unit ID results in a set of default parameters being assigned to the unit. The default parameters do not include the unit' s customer group. The default parameters can be displayed with the LIST command or changed with the EDIT command.

- ADD T803587 (Type II), 600 S01 (Type I) – The talk group ID is specified for Type II, with a space required between the ADD and the talk group ID.

  — Local limit level, authorization status level, 0+ and 1+ – these parameters are the same as described in the individual unit records.

  — L–M Access Number – The L –M access number for Type II talk groups is the 6 digit extension that is dialed by the land party when calling the talk group. The access number may be calculated by taking the digit 8 and appending the talk group ID number converted to a 5 position decimal number (leading zeros are significant). Type I systems use the 6 digit ID determined by the sizecode prefix, fleet, subfleet, and individual IDs.

When the system is first installed, the authorization tables are blank. The default condition for such a condition is that all mobile to land interconnect calls are authorized for 7–digit calling only in a *SmartNet* system and no interconnect calls in a *Privacy Plus* system. Land to mobile calls are authorized. The system limits interconnect authorization to those units that reside on the authorization table after the authorization list h as been activated through the Status command, which have the correct level of authorization.

The CIT (Central Interconnect Terminal) calculates land to mobile IDs based upon the unit ID or talk group ID for Type II, and, the prefix, fleet, subfleet, and individual for Type I. If the authorization table has to be reconstructed, the units may be entered in any order, as the order has nothing to do with the access number created.

2.2 TRAN COMMAND

The TRAN command provides the system manager with those commands necessary to build and maintain a table for 4–digit land–to–mobile access numbers. This is provided as a transition from your current *SMARTNET I* or *Privacy Plus* system to your *SMARTNET II/Privacy Plus* Enhanced environment. The command is used to build a data base from which a translation of the 6–digit overdial numbers is provided for the current Type I ID back to their 4–digit overdial number.

- The TRAN command is only available in systems which have Type I radios, and do not use any of the following sizecodes: G,H,I,J and/or K.
- Only Type I individual IDs can be assigned with a 4–digit access number.
- All Type II units, all Type I Subfleets, and all Type II Talk groups will be assigned only a 6–digit land–to–mobile access number.
- In addition to a Type I unit's 6–digit ID assigned by the AUTH command, a 4–digit land–to–mobile access number in the range of 1000–1699 can be assigned. A Type I unit can have several different 4–digit access numbers, although its 6–digit number remains fixed.

The TRAN command is entered by typing TRAN at the AUTH > prompt. The following table provides a description of the commands available at the TRAN > prompt. Entering the first letter (or up to the complete command) of the command is acceptable.

Command	Paragraph	Description
Add	2.2.1	Add Type I unit and assign 4–digit ID..
Delete	2.2.2	Delete Type I unit from database.
Reset	2.2.3	Clears all 4–digit translation entries.
List	2.2.4	Provides individual/complete database list.
Status	2.2.5	Translation table active/not active status.
Quit	2.2.5	Exit to Authorization prompt AUTH >.

2.2.1 ADD Command
(Refer to Figure 2.)

Syntax: TRAN > ADD FFF UUU *

This is interpreted as FFF being the customer group and UUU the radio unit. The asterisk (*) is accepted as an optional entry and doesn't really do anything. It is provided so that personal computer scripts run under the AUTH > command can be reused for TRAN >.

The ADD command allows a user to add a Type I unit ONLY to the database. Attempting to add a Type II unit, a Type II Talkgroup, or a Type I subfleet will result in an error message.

The ADD subcommand automatically assigns a four digit land to mobile access number to the Type I unit entered. The number to be assigned is the last deleted number. If there wasn't a number previously deleted, the unit is assigned the next consecutive number after the last number assigned. It is possible to have multiple 4–digit ID numbers assigned to the same unit.

2.2.2 DELETE Command
(Refer to Figure 3.)

Syntax: TRAN > DELETE FFF UUU

This is interpreted as FFF being the customer group and UUU the radio unit.

If the unit is a member of the database, its 4–digit ID number is displayed, along with a question verifying that this number actually IS is to be deleted. If so, the deleted 4–digit ID number will become the next ID number to be assigned when adding a new unit to the database.

When deleting a unit, the complete database is searched for multiple assignments. Each multiple assignment is verified for deletion.

2.2.3 RESET Command
(Refer to Figure 4.)

Syntax: TRAN > RESET

The RESET command clears out the database, sets the first 'to–be–assigned–number' to 1000, and sets the status of the translation table to INACTIVE. A question verifying RESET with the user is asked before actually resetting the table.

```
AUTH> TRAN(CR

TRAN> A 600 000(CR)
TRANSLATION IS 1000

TRAN> A 600 001(CR)
TRANSLATION IS 1001

TRAN> A 600 002(CR)
TRANSLATION IS 1002

TRAN> A 600 000(CR)
TRANSLATION IS 1003

TRAN>
```

Figure 2. ADD Command Example

```
AUTH> TRAN(CR)

TRAN> D 600 001(CR)
DELETE TRANSLATION 1001 (Y/N)? Y(CR)
 UNIT DELETED

TRAN> D 600 000(CR)
DELETE TRANSLATION 1001 (Y/N)? N(CR)
DELETE TRANSLATION 1003 (Y/N)? Y(CR)
 UNIT DELETED

TRAN>
```

Figure 3. DELETE Command Example

```
AUTH> TRAN(CR)

TRAN> R(CR)
RESET TRANSLATION TABLE ARE YOU SURE (Y/N)? Y(CR)
TRANSLATION TABLE RESET

TRAN>
```

Figure 4. RESET Command Example

```
AUTH> TRAN(CR)

TRAN> L(CR)
---------------------------------------------------------------------
CUSTOMER     UNIT   4 DIGIT    6 DIGIT
 GROUP        ID     ACCESS     ACCESS
---------------------------------------------------------------------
   600       000       1000      052224
   600       001       1001      052225
   600       002       1002      052226
   600       003       1003      052227
   600       000       1000      052224
   600       000       1000      052224

TRAN> L 600 002(CR)
---------------------------------------------------------------------
CUSTOMER     UNIT   4 DIGIT    6 DIGIT
 GROUP        ID     ACCESS     ACCESS
---------------------------------------------------------------------
   600       002       1002      052226

TRAN>
```

Figure 5. LIST Command Example

2.2.4 LIST Command
(Refer to Figure 5.)

Syntax: TRAN > LIST, or TRAN > LIST FFF UUU

This is interpreted as FFF being the customer group and UUU the radio unit.

The LIST command can list the complete database or a specific single Type I unit. If listing out the complete database, the units are displayed in order of 4–digit land–to–mobile access ID numbers.

Whether listing the whole database or a specific unit, the 6–digit land–to–mobile access ID number is displayed, as well as the 4–digit land–to–mobile access ID number.

2.2.5 STATUS Command
(Refer to Figure 6.)

Syntax: TRAN > STATUS

```
AUTH> TRAN(CR)

TRAN> S(CR)
TRANSLATION TABLE NOT ACTIVE
ACTIVATE TRANSLATION TABLE (Y/N)? Y(CR)

TRAN>
```

Figure 6. STATUS Command Example

```
AUTH> TRAN(CR)

TRAN> Q(CR)
TRANSLATION TABLE ACTIVE

AUTH>
```

Figure 7. QUIT Command Example

```
 GRD> AUTH(CR

AUTH> DEL I757349(CR)
 DELETE UNIT # 757349 (Y/N)? N(CR)

AUTH> DEL I757349(CR)
 DELETE UNIT # 757349 (Y/N)? Y(CR)
 UNIT DELETED

AUTH> DEL I757349(CR)
 NOT ON USER LIST

AUTH> DEL 600 100(CR)
    L-M ACCESS NUMBER IS 052480
 DELETE FLEET  # 600  UNIT # 100 (Y/N)? Y(CR)
 UNIT DELETED

AUTH> DEL T803587)CR)
 DELETE TALK GROUP # T803587 (Y/N)? Y(CR)
 TALK GROUP DELETED

AUTH> DEL 600 S01(CR)
 DELETE FLEET  # 600  SUBFLEET # 001 (Y/N)? Y(CR)
 TALK GROUP DELETED

AUTH> QUIT(CR)
ACTIVE USER LIST

 GRD>
```

Figure 8. DELETE Command Example

The STATUS command shows the current status of the translation table and allows the user to alter the status of the translation table. To allow 4-digit land-to-mobile ID number access, the status of the translation table must be ACTIVE. If the authorization (AUTH) status (see paragraph 2.6) is ACTIVE, the unit must also be a member of the authorization (AUTH) list to allow interconnections.

2.2.6 QUIT Command
(Refer to Figure 7.)

Syntax: TRAN > QUIT

The QUIT command shows the current status of the translation table, exits the TRAN command, and returns the user interface to the AUTH > prompt.

2.3 DELETE COMMAND
(Refer to Figure 8.)

The DELETE command removes an existing unit ID or talk group ID from the authorization table.

- DEL I757349 (Type II), 600 100 (Type I) – The unit ID for Type I, or, the fleet/individual ID for Type I, is entered following a mandatory space. The ID assigned to a radio should be printed on a label that is attached to the radio.
- DEL T803587 (Type II), 600 S01 (Type I) – The talk group ID is specified for Type II, with a space required between the DEL and the talk group ID.

2.4 EDIT COMMAND
(Refer to Figure 9.)

The EDIT command changes authorization parameters that are assigned to a particular unit or talk group for Type II, or, a fleet/individual or fleet/subfleet for Type I.

- EDIT I757349 (Type II), 600 100 (Type I) – The unit ID for Type II, or, the fleet/individual for Type I, is entered following a mandatory space. The ID assigned to the unit should be printed on a label attached to the radio.
- EDIT * – The * character specifies the default authorization parameter block. This block is simplifies the process of adding new users to the authorization table.
- EDIT T803587 (Type II), 600 S01 (Type I) – The talk group ID for Type II, or, the fleet/subfleet for Type I, is entered following a mandatory space.
- EDIT ROAMER (Option D610) – Changes authorization parameters that are assigned to the *CoveragePLUS* roaming units.

2.5 LIST COMMAND
(Refer to Figure 10.)

The LIST command displays the IDs of users and talk group IDs that reside on the authorization table with current settings for each ID.

The LIST command may be used in one of four different manners:

1. If the LIST command is issued with no arguments, all of the unit and talk group IDs are shown. In other words, the entire authorization table is shown.
2. If the LIST command is followed by a single unit ID or a talk group ID, the data for that single item is displayed.
3. If the LIST command is followed by an asterisk, the data for the default record is displayed.
4. If the LIST command is followed by a range of IDs, the unit and talk group IDs that fall into the range listed. If the LIST command is followed by a customer group numbers, all unit and talk group IDs which are in that customer group are listed.

A description of the Figure 10 example follows.

- LIST (Type I and Type II) – The authorization table for the entire system is displayed.
- LIST 600 011 (Type I) – Authorizations for the individual unit are displayed.
- LIST I757346–I757350 (Type II) – Authorizations for the units that fall within the range are displayed.
- LIST 600 S01 (Type I) – Authorizations for a subfleet are displayed.
- LIST T803587 (Type II) – Authorizations for the talk group are displayed.
- LIST * – The default authorization record is displayed.
- LIST G000 (Type I and Type II) – Authorizations for units and talk groups within the customer group are displayed.
- LIST POOL (Option D610) – The temporary ID pool for *CoveragePLUS* roaming units is displayed.
- LIST ROAMER (Option D610) – Authorizations for the *CoveragePLUS* roaming units are displayed.

2.6 STATUS COMMAND
(Refer to Figure 11.)

The STATUS command enables or disables the authorization process. After the system is first turned on or after a loss of memory, the authorization status defaults to an inactive state which limits the calling capability of mobile–to–land calls to 7–digit phone numbers in a *SmartNet* system and no interconnect calls in a *Privacy Plus* system. The status should not be made active until all units have been re–entered to the authorization table preventing units that should be on the list from being locked out of the system. The status of the authorization list is given to the system manager when leaving the authorization command family.

2.7 PDIGIT COMMAND
(Refer to Figure 12.)

The PDIGIT command allows the system manager to specify a digit sequence dialed from a radio that is to be passed on to the TELCO office, but is to be ignored by the CIT. An authorization check or TELCO charge calculation is not performed on the pre–digit sequence. A pre–digit sequence is required by some TELCO offices to be able to dial a toll call.

```
 GRD> AUTH(CR)

AUTH> EDIT I757349(CR)
    L-M ACCESS NUMBER IS 757349
 1. HALF DUPLEX
 2. LOCAL CALL LIMIT LEVEL 4
 3. AUTHORIZATION LEVEL 4
 4. 0+ DIALING ENABLED
 5. 1+ DIALING ENABLED
 6. CUSTOMER GROUP NUMBER 017
 ENTER # OF PARAMETER TO CHANGE OR Q TO QUIT: 2(CR)
 ENTER LOCAL LIMIT LEVEL (1-4): 2(CR)
 ENTER # OF PARAMETER TO CHANGE OR Q TO QUIT: Q(CR)

AUTH> EDIT 600 100(CR)
    L-M ACCESS NUMBER IS 052480
 1. HALF DUPLEX
 2. LOCAL CALL LIMIT LEVEL 3
 3. AUTHORIZATION LEVEL 3
 4. 0+ DIALING ENABLED
 5. 1+ DIALING ENABLED
 ENTER # OF PARAMETER TO CHANGE OR Q TO QUIT: 2(CR)
 ENTER LOCAL LIMIT LEVEL (1-4): 2(CR)
 ENTER # OF PARAMETER TO CHANGE OR Q TO QUIT: Q(CR)

 AUTH> EDIT *(CR
 1. HALF DUPLEX
 2. LOCAL CALL LIMIT LEVEL 2
 3. AUTHORIZATION LEVEL 4
 4. 0+ DIALING DISABLED
 5. 1+ DIALING DISABLED
 ENTER # OF PARAMETER TO CHANGE OR Q TO QUIT: 2(CR)
 ENTER LOCAL LIMIT LEVEL (1-4): 2(CR)
 ENTER # OF PARAMETER TO CHANGE OR Q TO QUIT: Q(CR)

 AUTH> EDIT T803587(CR)
    L-M ACCESS NUMBER IS 803587
 3. AUTHORIZATION LEVEL 4
 6. CUSTOMER GROUP NUMBER 017
 ENTER # OF PARAMETER TO CHANGE OR Q TO QUIT: 6(CR)
 ENTER CUSTOMER GROUP: 018(CR)
 ENTER # OF PARAMETER TO CHANGE OR Q TO QUIT: Q(CR)

 AUTH> EDIT 600 S01(CR)
    L-M ACCESS NUMBER IS 949664
 3. AUTHORIZATION LEVEL 2
 ENTER # OF PARAMETER TO CHANGE OR Q TO QUIT 3(CR)
 ENTER AUTHORIZATION STATUS LEVEL (1-5): 3(CR)
 ENTER # OF PARAMETER TO CHANGE OR Q TO QUIT Q(CR)

 AUTH> EDIT ROAMER(CR)
 1. FULL DUPLEX
 3. AUTHORIZATION LEVEL 2                ☜ -- With option D610
 4. 0+ DIALING ENABLED
 5. 1+ DIALING ENABLED
 ENTER # OF PARAMETER TO CHANGE OR Q TO QUIT:

 AUTH>
ACTIVE USER LIST

 GRD>
```

Figure 9. EDIT Example

When the system is first installed or after a loss of memory, the pre–digit table is blank. A blank entry is indicated by a series of X's. This table has capacity for up to 5 pre–digit sequences with up to 5 digits for each sequence. Entering a (cr) after a line output causes the program to advance to the next sequence without modifying the current pre–digit sequence. A pre–digit sequence is modified by entering the sequence as shown. A pre–digit sequence is deleted by entering a X as shown. This command cannot be terminated with the Quit commands until all five sequences are listed.

2.8 UPDATE COMMAND
(Refer to Figure 13.)

The UPDATE command updates the master authorization table with the changes stored in the temporary Add and Delete tables. This command should be used after additions or deletions have been made before the LIST or other commands are given. Otherwise, the changes are made to the master authorization table when the user leaves the AUTH subsystem.

Changes caused by the ADD and DELETE commands are stored in a temporary memory area to make access to the master table faster. The records are stored in the master table in a sorted fashion. When the user leaves AUTH or issues the UPDATE command, the records are moved into the proper locations in the master table. This is usually done only once during each session to reduce processing of the table.

2.9 RESET COMMAND
(Refer to Figure 14.)

The RESET command causes authorization table, billing, call records and nearby area code exchanges entries to be cleared, setting these functions to the same state as when power was first applied to the system. Authorization and billing data bases should then be initialized.

NOTE

The RSET sub–command of the BILL command can be used in conjunction with the Reset command to retrieve parts of the previously entered billing information without re–entering the billing information by using the INIT command. The RSET command, in this case, is used after the Reset command as described in paragraph 3.15 .

```
GRD> AUTH(CR
AUTH> LIST(CR)
-----------------------------------------------------------------------
CUSTOMER UNIT      DUPLEX    LOCAL   AUTH.      ENABLED        LAND
  GROUP   ID        TYPE     LEVEL   LEVEL    0+      1+      ACCESS
-----------------------------------------------------------------------
   000    001       HALF       4       4      YES     YES     229377
   000    015       HALF       2       4      NO      NO      229397
   000    068       HALF       2       4      NO      NO      229480
   000    S01       HALF       2       4      NO      NO      902048

   100    001       HALF       2       4      NO      NO      229377

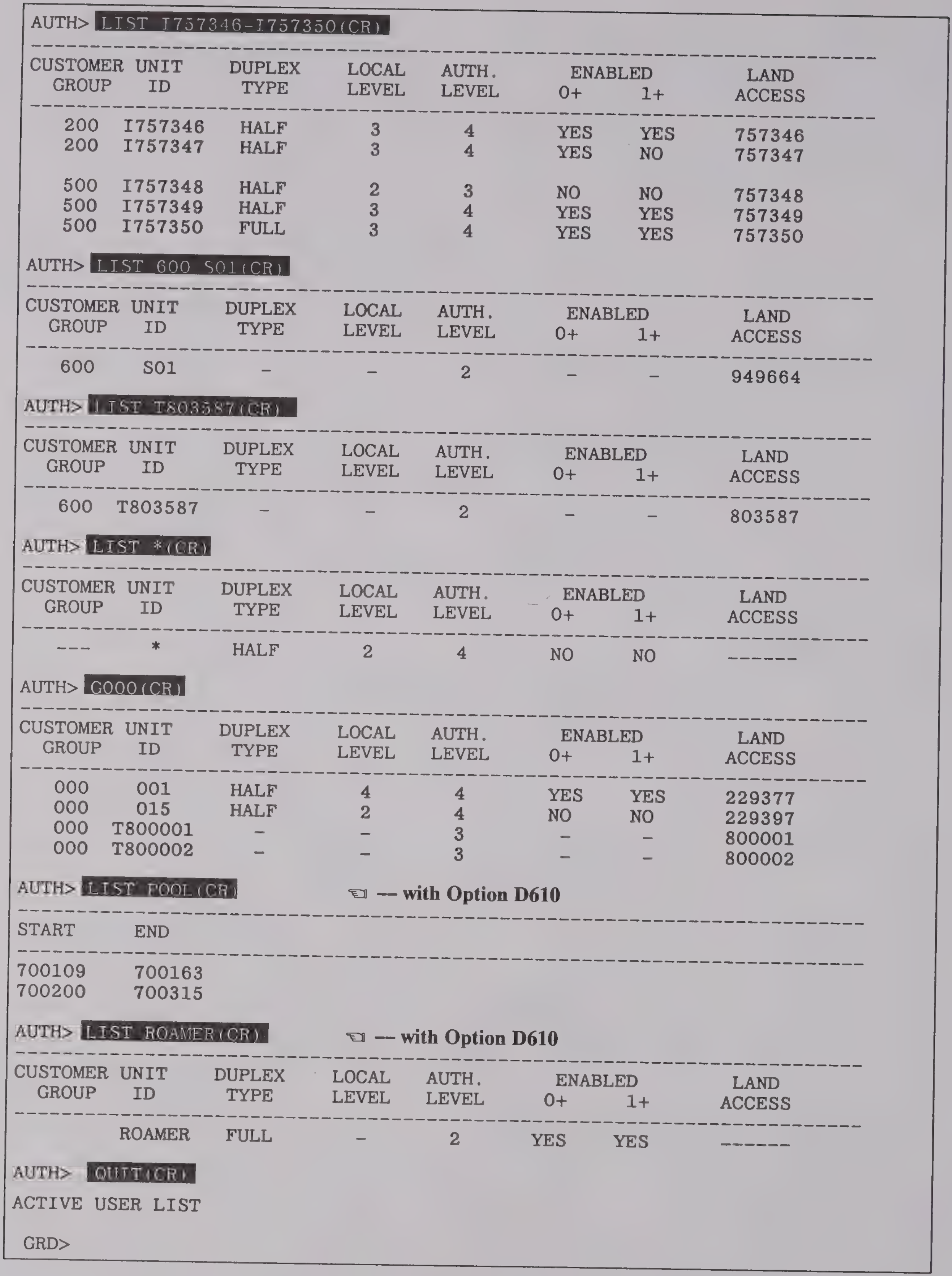
   600    011       HALF       2       4      NO      NO      052241
   600    S01       HALF       2       4      NO      NO      949664

   700  I757344     HALF       3       4      YES     YES     757344
   700  I757345     HALF       2       4      NO      NO      757345
   700  T803585      -         -       4      -       -       803585

AUTH> LIST 600 001(CR)
-----------------------------------------------------------------------
CUSTOMER UNIT      DUPLEX    LOCAL   AUTH.      ENABLED        LAND
  GROUP   ID        TYPE     LEVEL   LEVEL    0+      1+      ACCESS
-----------------------------------------------------------------------
   600    011       HALF       2       4      NO      NO      052241

AUTH>
```

Figure 10. LIST Command Example (Sheet 1 of 2)



```
AUTH> LIST I757346-I757350(CR)
--------------------------------------------------------------------------------
CUSTOMER UNIT      DUPLEX     LOCAL    AUTH.        ENABLED           LAND
  GROUP    ID       TYPE      LEVEL    LEVEL      0+        1+        ACCESS
--------------------------------------------------------------------------------
   200   I757346    HALF        3        4       YES       YES       757346
   200   I757347    HALF        3        4       YES       NO        757347

   500   I757348    HALF        2        3       NO        NO        757348
   500   I757349    HALF        3        4       YES       YES       757349
   500   I757350    FULL        3        4       YES       YES       757350
AUTH> LIST 600 S01(CR)
--------------------------------------------------------------------------------
CUSTOMER UNIT      DUPLEX     LOCAL    AUTH.        ENABLED           LAND
  GROUP    ID       TYPE      LEVEL    LEVEL      0+        1+        ACCESS
--------------------------------------------------------------------------------
   600     S01        -          -       2         -         -       949664
AUTH> LIST T803587(CR)
--------------------------------------------------------------------------------
CUSTOMER UNIT      DUPLEX     LOCAL    AUTH.        ENABLED           LAND
  GROUP    ID       TYPE      LEVEL    LEVEL      0+        1+        ACCESS
--------------------------------------------------------------------------------
   600   T803587      -          -       2         -         -       803587
AUTH> LIST *(CR)
--------------------------------------------------------------------------------
CUSTOMER UNIT      DUPLEX     LOCAL    AUTH.        ENABLED           LAND
  GROUP    ID       TYPE      LEVEL    LEVEL      0+        1+        ACCESS
--------------------------------------------------------------------------------
   ---      *       HALF        2        4       NO        NO        ------
AUTH> G000(CR)
--------------------------------------------------------------------------------
CUSTOMER UNIT      DUPLEX     LOCAL    AUTH.        ENABLED           LAND
  GROUP    ID       TYPE      LEVEL    LEVEL      0+        1+        ACCESS
--------------------------------------------------------------------------------
   000     001      HALF        4        4       YES       YES       229377
   000     015      HALF        2        4       NO        NO        229397
   000   T800001      -          -       3         -         -       800001
   000   T800002      -          -       3         -         -       800002
AUTH> LIST POOL(CR)                  ☜ -- with Option D610
--------------------------------------------------------------------------------
START      END
--------------------------------------------------------------------------------
700109     700163
700200     700315
AUTH> LIST ROAMER(CR)                ☜ -- with Option D610
--------------------------------------------------------------------------------
CUSTOMER UNIT      DUPLEX     LOCAL    AUTH.        ENABLED           LAND
  GROUP    ID       TYPE      LEVEL    LEVEL      0+        1+        ACCESS
--------------------------------------------------------------------------------
          ROAMER    FULL        -        2       YES       YES       ------
AUTH> QUIT(CR)
ACTIVE USER LIST
 GRD>
```

Figure 10. LIST Command Example (Sheet 2 of 2)

```
 GRD> AUTH(CR)
AUTH> STAT(CR)
AUTHORIZATION INACTIVE
ACTIVATE AUTHORIZATION LIST (Y/N)? Y(CR)

AUTH> STAT(CR)
AUTHORIZATION ACTIVE
ACTIVATE AUTHORIZATION LIST (Y/N)? N(CR)

AUTH> QUIT(CR)
ACTIVE USER LIST

 GRD>
```

Figure 11. STATUS Command Example

```
 GRD> AUTH(CR)
AUTH> PDIGIT(CR)
XXXXX: (CR)
XXXXX: (CR)
XXXXX: (CR)
XXXXX: (CR)
XXXXX: (CR)
AUTH> PDIGIT(CR)
XXXXX: 123(CR)
XXXXX: 31(CR)
XXXXX 471(CR)
XXXXX: (CR)
XXXXX: (CR)
AUTH> PDIGIT(CR)
123: (CR)
31: X(CR)
471: (CR)
XXXXX: (CR)
XXXXX: 789(CR)
AUTH> PDIGIT(CR)
123: (CR)
XXXXX: (CR)
471: (CR)
XXXXX: (CR)
789: (CR)
AUTH> QUIT(CR)
ACTIVE USER LIST

 GRD>
```

Figure 12. PDIGIT Command Example

```
 GRD> AUTH(CR

AUTH> UPD(CR)

AUTH>
```

Figure 13. UPDATE Command Example

```
 GRD> AUTH(CR)

AUTH> RESET(CR)
 CLEAR ALL AUTHORIZATION & BILLING DATA, ARE YOU SURE (Y/N):
AUTHORIZATION & BILLING RESET

AUTH>
```

Figure 14. RESET Command Example

```
AUTH> QUIT(CR)
ACTIVE USER LIST

 GRD>
```

Figure 15. Authorization QUIT Command Example

2.10 MSAVE COMMAND

The MSAVE command causes the MCB to send a copy of memory to a recording device. This command works in a way similar to that of the SAC (subscriber access control) CSAVE command described in instruction section 68P81081E87, which just precedes this Section in this manual. Records are saved using an error–checking process. A record received in error will be resent; this is not the case when using the old GRDD command to save the MCB database.

The MSAVE command (unlike the old GRDD command) permits interconnect call activity during the save function.

The MCB authorization list is automatically updated before saving the records. A system manager terminal (SMT) is required on the intelligent end.

2.11 MLOAD COMMAND

The MLOAD command causes the MCB to read data from an intelligent storage device, check the data received, and, if valid, place the data into the proper location in memory. This command works similarly to the SAC CLOAD command. Authorization records are set to default during MLOAD, allowing interconnect calls to take place in a *SmartNet* system, but not in a *Privacy Plus* system. However, the default record can be modified in either system to change operation of interconnect activity when operating under default records (i.e., AUTHORIZATION is INACTIVE).

ALL LONG DISTANCE RECORDS ARE CLEARED upon issuing an MLOAD command. Consequently, obtain a copy of these records, by using the SLNG or CLNG commands for the BILL command (refer to paragraph 3.12) **BEFORE** executing the MLOAD command. An SMT is required on the intelligent end.

NOTE

Before attempting the MLOAD command the TRIB to central controller connections must be specified. Refer to the TELL command in section 4.

After MLOAD is completed, a prompt is issued allowing activation of the AUTHORIZATION records. If the AUTHORIZATION records are set to ACTIVE, then the BILL > RSET command must be issued to activate billing. Refer to paragraph 3.15 for BILL > RSET information.

2.12 QUIT COMMAND
(Refer to Figure 15.)

The QUIT command exits from AUTH. Control is returned to the GRD > prompt. This command automatically updates the master authorization table with Add and Delete temporary tables.

3. BILL COMMAND

The BILL command family provides the system manager with commands necessary to initially enter and subsequently list and modify parameters used by the CIT to generate airtime and TELCO charges. Summary commands are provided for the purpose of listing airtime charges, TELCO charges and long distance/toll call records for each authorized user of the system.

NOTE

If an attempt is made to use a routine other than INIT when the system is first turned on, after a loss of memory, or in the DEFAULT mode the message 'MUST USE 'INIT' COMMAND FIRST' is displayed. An attempt to output charge summaries (CLNG, SAIR, STEL, SLNG) before both the Authorization and Billing Defaults are cleared (Status set to active state) results in the message 'MUST SET AUTH & BILL ACTIVE FIRST'.

BILL Command Summary

Command	Paragraph	Description
INIT	3.1	Initialize airtime and TELCO charge parameters.
LAIR	3.2	List airtime charge parameters.
LTEL	3.3	List TELCO charge parameters.
LEXC	3.4	List exchange rate parameters.
MAIR	3.5	Modify airtime charge parameters.
MTEL	3.6	Modify TELCO charge parameters.
MEXC	3.7	Modify exchange rate parameters.
AEXC	3.8	Add exchanges and nearby area codes to billing parameters.
DEXC	3.9	Delete exchanges and all area codes from billing parameters.
SAIR	3.10	Summarize airtime charge listing.
STEL	3.11	Summarize TELCO charge listing.
CLNG	3.12	Summarize logged call listing – computer format.
SLNG	3.12	Summarize logged calls listing.
LOGN	3.13	Log long distance calls only.
LOGY	3.13	Log all calls.
PBXN	3.14	Remove special call processing.
PBXY	3.14	Establish special call processing.
RSET	3.15	Enable or disable airtime and TELCO charge calculations.
GRDD	3.16	Save/restore memory information to/from tape.
QUIT	3.17	Exit to GUARDIAN prompt GRD.

3.1 INIT COMMAND

3.1.1 Introduction

The INIT command enters those system parameters required by the CIT to calculate charges for airtime and local calls. The command is to be executed once: **1)** after the system is first turned on; **2)** after a loss of memory; or **3)** after RESET command execution. The AEXC, DEXC, MAIR, MTEL and MEXC commands are used to modify data entered with the INIT command.

Before using the INIT command, choose a billing method for airtime and TELCO charge calculation. The different methods available in the CIT are identified and explained in detail through the following examples.

NOTE

Due to the large number of data entries, the INIT command can be suspended at any time by entering "Q" instead of the requested data input. When the INIT command is subsequently entered, a prompt is provided that permits the INIT program to be restarted at the suspension point.

Two different types of Airtime billing methods are available, flat and variable.

- Flat – Flat billing establishes a set amount per minute to be charged for airtime, regardless of the time of day or the day of the week.
- Variable – Variable billing establishes charges based on the time of day and the day of the week

3.1.2 Flat Rate Airtime and TELCO Billing

(Refer to Figure 16.)

- Airtime billing method – Flat (refer to paragraph 3.1.1).
- Start date – The billing start date specifies the billing period for airtime charges.

NOTE

The number 28 is the largest number that can be specified since February usually has only 28 days.

- Tax rate – Tax rate in % (federal, state, and local) that would apply to airtime charges.
- Minimum fee – Minimum airtime charge billed per user regardless of actual airtime used .
- Airtime rate – Charge per minute for interconnect type calls.
- TELCO billing method – Three different types of billing methods are available to provide the flexibility of selecting the method that most closely matches that of the local TELCO office.

  1. Flat – TELCO offices that bill using a flat method charge a fixed amount per month for local call service regardless of the number of calls made or the length of the calls.
  2. Metered – TELCO offices bill a fixed amount per local call in addition to a basic service charge for metered service.
  3. Variable – TELCO offices bill a variable amount per local call based on call length and exchange dialed.

- Start date – The start date for TELCO charges should coincide with the billing date of the TELCO office.
- TELCO fee – All basic service charges assessed by the TELCO office that are to be spread among all users of the system.
- Local call limit – Up to 4 local call limit levels can be specified for the system. These levels establish a credit level for each authorized user of the system. A user who exceeds the assigned call limit level is not allowed to make further calls until the call limit is increased.

NOTE
(Option D610) – *CoveragePLUS* roaming units do not have a Local Call Limit.

- Tax rate – Tax rate in % to be applied to TELCO charges.
- Area code – Area code of the TELCO office that provides phone line service to the CIT terminal.
- Free exchanges – Those exchanges that are covered by the basic TELCO service charges for the flat method of billing must be specified. Calls to exchanges not specified as free exchanges are treated as toll calls. No TELCO charges are calculated for toll calls by the CIT. A record of the number dialed and the unit ID is saved in memory to be listed out with the CLNG or SLNG commands.

NOTE
A particular nearby area code can only be entered once with the INIT command. If all the exchanges were not entered for a particular area code, the AEXC comm and must be used after completing the INIT command sequence.

3.1.3 Variable Airtime and Metered TELCO Billing
(Refer to Figure 17.)

- Airtime billing method – Variable (refer to paragraph 3.1.1).
- Start date, Tax rate, and Minimum fee – Refer to the descriptions provided in paragraph 3.1.2.
- Free minutes – Equals the number of initial airtime minutes per month per user that are not billed.
- Airtime rate – Up to six different system rates can be specified for airtime charge calculation. The rates are used by the CIT to calculate airtime charges based up on the hour of the day in which the call was made. The default value for a rate is $0.00.
- Rate choices – An airtime rate (1–6) is specified for each hour of the day for the time periods of weekdays and weekends.
- TELCO billing method, Start date, TELCO fee, Local call limit, Tax rate – Refer to the descriptions provided in paragraph 3.1.2.
- Metered call charges – Fixed per call charge applied to those exchanges specified as being metered.
- Free exchanges – List of all exchanges that are not billed.
- Metered exchanges – List of all exchanges that are to be billed at the specified metered rate.
- Exchanges that are not specified as free or metered are treated as toll calls.

NOTE
A particular nearby area code can only be entered once with the INIT command. If all the exchanges were not entered for a particular are code, the AEXC command must be used after completing the INIT command sequence.

3.1.4 Flat Rate Airtime and Variable TELCO Billing
(Refer to Figure 18.)

- Airtime billing method – Flat (refer to paragraph 3.1.1).
- Start date, Tax rate, and Minimum fee – Refer to the descriptions provided in paragraph 3.1.2.
- TELCO billing method, Start date, TELCO fee, Local call limit, Tax rate – Refer to the descriptions provided in paragraph 3.1.2.
- Unit charge – A unit of measure of telephone service used by the TELCO office to charge for dialed local calls. The distance to the dialed exchange and the duration of the call determine the number of units charged to a call. The unit charge is the rate set by the TELCO office for this basic unit of service. Note that the entry for unit charge is in cents.
- Initial billing period – The initial billing period specified the minimum duration of a call for billing purposes only. The initial talking period is set by the billing rate structure of the TELCO office. Calls lasting longer than the initial talk period are billed for overtime charges.
- Thereafter time period – The thereafter time period specifies the minimum overtime charge period in minutes for calls lasting longer than the initial billing period. The flexibility exists to specify different thereafter time periods based upon the number of units charges to the initial time period. An example follows.

Basic Charge	Initial Period	Thereafter Period	Overtime Charges
2, 3 Units	3 minutes	2 minutes	1 unit
4, 5, 6, 7 Units	3 minutes	1 minute	1 unit
8, 9, 10 Units	3 minutes	1 minute	2 units

```
GRD> BILL(CR)

BILL> INIT(CR)
ENTER THE REQUESTED AIRTIME BILLING INFORMATION.
BILLING METHOD (FLAT/VARIABLE): FLAT(CR)
BILLING START DATE (01-28): 1(CR)
TAX RATE (XX.XX): 1.00(CR)
MINIMUM FEE (XXX.XX)? 5.00(CR)
AIRTIME RATE (X.XX)? 0.25(CR)
ENTER THE REQUESTED TELCO BILLING INFORMATION
BILLING METHOD (FLAT/METERED/VARIABLE)? FLAT(CR)
BILLING START DATE (01-28): 15(CR)
FIXED MONTHLY TELCO FEE. LESS TAX (XXXX.XX)? 67.29(CR)
LOCAL CALL LIMIT: LEVEL 1 (XXX.XX)? 5.00(CR)
LOCAL CALL LIMIT: LEVEL 2 (XXX.XX)? 25.00(CR)
LOCAL CALL LIMIT: LEVEL 3 (XXX.XX)? 50.00(CR)
LOCAL CALL LIMIT: LEVEL 4 (XXX.XX)? 100.00(CR)
FEDERAL TAX RATE (X.XX)? 2.50(CR)
STATE TAX RATE (X.XX)? 5.25(CR)
LOCAL TAX RATE (X.XX)? 3.75(CR)
LOCAL AREA CODE (XXX)? 312(CR)
FEDERAL TAX ON CALLS TO THIS AREA CODE (Y/N)? N(CR)
STATE TAX ON CALLS TO THIS AREA CODE (Y/N)? Y(CR)
LOCAL TAX ON CALLS TO THIS AREA CODE (Y/N)? Y(CR)
ENTER ALL FREE EXCHANGES WITHIN THIS AREA CODE.
HIT (CR) TO QUIT.
EXCHANGE (XXX)? 576(CR)
EXCHANGE (XXX)? (CR)
EXCHANGE (XXX)? (CR)
EXCHANGE (XXX)? (CR)
ENTER NEARBY AREA CODES WITH FREE EXCHANGES.
HIT (CR) TO QUIT.
NEARBY AREA CODE (XXX)? 815(CR)
ENTER ALL FREE EXCHANGES WITHIN THIS AREA CODE.
HIT (CR) TO QUIT.
EXCHANGE (XXX)? (CR)
ENTER NEARBY AREA CODES WITH FREE EXCHANGES.
HIT (CR) TO QUIT.
NEARBY AREA CODE (XXX)? (CR)
USE 'INIT' INPUT TO CALCULATE BILLING CHARGES (Y/N)? Y(CR)

BILL> Q(CR)

GRD>
```

Figure 16.   INIT Command – Flat Rate Method Example

```
 GRD> BILL(CR)

BILL> INIT(CR)
ENTER THE REQUESTED AIRTIME BILLING INFORMATION.
BILLING METHOD (FLAT/VARIABLE): v(CR)
BILLING START DATE (01-28): 1(CR)
TAX RATE (XX.XX): 5.00(CR)
MINIMUM FEE (XXX.XX)? 5.00(CR)
FREE MINUTES (XXX)? 10(CR)
AIRTIME RATE 1 (X.XX)/MIN? .25(CR)
AIRTIME RATE 2 (X.XX)/MIN? .35(CR)
AIRTIME RATE 3 (X.XX)/MIN? .50(CR)
AIRTIME RATE 4 (X.XX)/MIN? 1.00(CR)
AIRTIME RATE 5 (X.XX)/MIN? .10(CR)
AIRTIME RATE 6 (X.XX)/MIN? .00(CR)
ENTER RATE CHOICES FOR WEEKDAY HOURS
HOUR    0 (1-6)? (CR)
HOUR    1 (1-6)? (CR)
HOUR    2 (1-6)? (CR)
....
....
....
HOUR   22 (1-6)? (CR)
HOUR   23 (1-6)? (CR)
ENTER RATE CHOICES FOR WEEKEND HOURS
HOUR    0 (1-6)? (CR)
HOUR    1 (1-6)? (CR)
HOUR    2 (1-6)? (CR)
....
....
....
HOUR   22 (1-6)? (CR)
HOUR   23 (1-6)? (CR)
ENTER THE REQUESTED TELCO BILLING INFORMATION
BILLING METHOD (FLAT/METERED/VARIABLE)? M(CR)
BILLING START DATE (01-28): 15(CR)
FIXED MONTHLY TELCO FEE. LESS TAX (XXXX.XX)? 67.29(CR)
LOCAL CALL LIMIT: LEVEL 1 (XXX.XX)? 5.00(CR)
LOCAL CALL LIMIT: LEVEL 2 (XXX.XX)? 25.00(CR)
LOCAL CALL LIMIT: LEVEL 3 (XXX.XX)? 50.00(CR)
LOCAL CALL LIMIT: LEVEL 4 (XXX.XX)? 100.00(CR)
FEDERAL TAX RATE (X.XX)? 2.50(CR)
STATE TAX RATE (X.XX)? 2.50(CR)
LOCAL TAX RATE (X.XX)? 2.50(CR)
CHARGE PER METERED CALL (XX.XX CENTS)? 45.00(CR)
LOCAL AREA CODE (XXX)? 312
FEDERAL TAX ON CALLS TO THIS AREA CODE (Y/N)? N(CR)
STATE TAX ON CALLS TO THIS AREA CODE (Y/N)? N(CR)
LOCAL TAX ON CALLS TO THIS AREA CODE (Y/N)? N(CR)
ENTER ALL FREE EXCHANGES WITHIN THIS AREA CODE.
HIT (CR) TO QUIT.
EXCHANGE (XXX)? 576(CR)
```

Figure 17. INIT Command – Variable Airtime and Metered TELCO Billing Method Example (Sheet 1 of 2)

```
EXCHANGE (XXX)? 359(CR)
EXCHANGE (XXX)? 839(CR)
EXCHANGE (XXX)? (CR)
ENTER ALL METERED EXCHANGES WITHIN THIS AREA CODE.
HIT (CR) TO QUIT.
EXCHANGE (XXX)? 890(CR)
EXCHANGE (XXX)? 554(CR)
EXCHANGE (XXX)? 857(CR)
EXCHANGE (XXX)? (CR)
ENTER NEARBY AREA CODES WITH FREE OR METERED EXCHANGES.
HIT (CR) TO QUIT.
NEARBY AREA CODE (XXX)? 815(CR)
FEDERAL TAX ON CALLS TO THIS AREA CODE (Y/N)? Y(CR)
STATE TAX ON CALLS TO THIS AREA CODE (Y/N)? Y(CR)
LOCAL TAX ON CALLS TO THIS AREA CODE (Y/N)? Y(CR)
ENTER ALL FREE EXCHANGES WITHIN THIS AREA CODE.
HIT (CR) TO QUIT.
EXCHANGE (XXX)? 540(CR)
EXCHANGE (XXX)? 459(CR)
EXCHANGE (XXX)? (CR)
ENTER ALL METERED EXCHANGES WITHIN THIS AREA CODE.
HIT (CR) TO QUIT.
EXCHANGE (XXX)? 653(CR
EXCHANGE (XXX)? 728(CR
EXCHANGE (XXX)? (CR)
ENTER NEARBY AREA CODES WITH FREE OR METERED EXCHANGES.
HIT (CR) TO QUIT.
NEARBY AREA CODE (XXX)? (CR)
USE 'INIT' INPUT TO CALCULATE BILLING CHARGES (Y/N)? Y(CR)

BILL> Q(CR)

 GRD>
```

Figure 17. INIT Command – Variable Airtime and Metered TELCO Billing Method Example (Sheet 2 of 2)

- Rate for Area Code Exchanges (Exchange rates) – For each exchange between 200 and 999, the system manager is required to specify the initial and the thereafter unit charges. The initial unit charge specifies the number of units charges to a call for the initial TELCO billing period. The thereafter unit charge specifies the number of units charged to a call for each thereafter time period beyond the initial billing period. Entering a carriage return (CR) for the initial unit charge of a particular exchange causes all calls to that exchange to be treated as toll calls. No TELCO charges are calculated for toll calls by the CIT. A record of the number dialed and the radio unit ID is saved in memory to be listed out with the SLNG command.

NOTE

A particular nearby area code can only be entered once with the INIT command. If all the exchanges were not entered for a particular area code, the AEXC command must be used after completing the INIT command sequence.

```
 GRD> BILL(CR)

BILL> INIT(CR)
ENTER THE REQUESTED AIRTIME BILLING INFORMATION.
BILLING METHOD (FLAT/VARIABLE): FLAT(CR)
BILLING START DATE (01-28): 1(CR)
TAX RATE (XX.XX): 1.00(CR)
MINIMUM FEE (XXX.XX)? 5.00(CR)
AIRTIME RATE (X.XX)? 0.25(CR)
ENTER THE REQUESTED TELCO BILLING INFORMATION
BILLING METHOD (FLAT/METERED/VARIABLE)? V(CR)
BILLING START DATE (01-28): 15(CR)
FIXED MONTHLY TELCO FEE. LESS TAX (XXXX.XX)? 67.29(CR)
LOCAL CALL LIMIT: LEVEL 1 (XXX.XX)? 5.00(CR)
LOCAL CALL LIMIT: LEVEL 2 (XXX.XX)? 25.00(CR)
LOCAL CALL LIMIT: LEVEL 3 (XXX.XX)? 50.00(CR)
LOCAL CALL LIMIT: LEVEL 4 (XXX.XX)? 100.00(CR)
FEDERAL TAX RATE (X.XX)? 2.50(CR)
STATE TAX RATE (X.XX)? 5.25(CR)
LOCAL TAX RATE (X.XX)? 3.75(CR)
UNIT CHARGE (XX.XX CENTS)? 5.29(CR)
INITIAL TELCO BILLING TIME PERIOD (X) MINS? 3(CR)
ENTER THEREAFTER TIME PERIOD FOR INITIAL UNIT CHARGE OF:     0 (X)MINS 2(CR)
ENTER THEREAFTER TIME PERIOD FOR INITIAL UNIT CHARGE OF:     1 (X)MINS 2(CR)
....
....
....
ENTER THEREAFTER TIME PERIOD FOR INITIAL UNIT CHARGE OF:    14 (X)MINS 4(CR)
ENTER THEREAFTER TIME PERIOD FOR INITIAL UNIT CHARGE OF:    15 (X)MINS 4(CR)
LOCAL AREA CODE (XXX)? 312(CR)
FEDERAL TAX ON CALLS TO THIS AREA CODE (Y/N)? N(CR)
STATE TAX ON CALLS TO THIS AREA CODE (Y/N)? N(CR)
LOCAL TAX ON CALLS TO THIS AREA CODE (Y/N)? N(CR)
ENTER THE RATES FOR THE FOLLOWING AREA CODE EXCHANGES.
HIT (CR) FOR UNKNOWN OR TOLL RATES. THE RATE WILL BE SET TO TOLL
EXCHANGE 200.
INITIAL UNITS (XX)? 2(CR)
THEREAFTER UNITS (XX)? 1(CR)
EXCHANGE 201.
INITIAL UNITS (XX)? 5(CR)
THEREAFTER UNITS (XX)? 2(CR)
EXCHANGE 202.
INITIAL UNITS (XX)? 15(CR)
THEREAFTER UNITS (XX)? 4(CR
....
....
....
EXCHANGE 998.
INITIAL UNITS (XX)? 10(CR)
THEREAFTER UNITS (XX)? 3(CR)
EXCHANGE 999.
INITIAL UNITS (XX)? 2(CR)
THEREAFTER UNITS (XX)? 1(CR)
```

Figure 18. INIT Command – Flat Rate Airtime and Variable TELCO Billing Method Example (Sheet 1 of 2)

```
ENTER NEARBY AREA CODES WITH NONTOLL EXCHANGES.
HIT (CR) TO QUIT.
NEARBY AREA CODE (XXX)? 815(CR)
FEDERAL TAX ON CALLS TO THIS AREA CODE (Y/N)? N(CR)
STATE TAX ON CALLS TO THIS AREA CODE (Y/N)? N(CR)
LOCAL TAX ON CALLS TO THIS AREA CODE (Y/N)? N(CR)
ENTER NONTOLL EXCHANGES AND THEIR RATES FOR THIS AREA CODE. HIT (CR) TO QUIT
EXCHANGE (XXX)? 455(CR)
INITIAL UNITS (XX)? 2(CR
THEREAFTER UNITS (XX)? 1(CR)
EXCHANGE (XXX)? 459(CR
INITIAL UNITS (XX)? 2(CR)
THEREAFTER UNITS (XX)? 1(CR)
EXCHANGE (XXX)? (CR)
ENTER NEARBY AREA CODES WITH NONTOLL EXCHANGES.
HIT (CR) TO QUIT.
NEARBY AREA CODE (XXX)? (CR)
USE 'INIT' INPUT TO CALCULATE BILLING CHARGES (Y/N)? Y(CR)

BILL> Q(CR)

 GRD>
```

Figure 18. INIT Command – Flat Rate Airtime and Variable TELCO Billing Method Example (Sheet 2 of 2)

- Billing – If the local area code uses exchanges that have a 1 or 0 as the second digit, e.g., 310–1234 or 408–1234, then set the exchange rate for exchange 300 to something other than TOLL (which is 15,15) . (A unit rate of 15,15 is a default value that specifies that the exchange is a toll exchange.) Even if the exchange 300 is not used in the local area code, set exchange 300 to something like 01,00. Doing this allows any 7-digit number to be processed, if authorized as usual, no matter if the exchange 'looks like' an area code. Dialing other area codes in this case is always preceded by a 1. TELCO credit card calls can be 7 or 10 digits past the initial 0. For 7–digit 0+ calls, the interconnect unit waits 10 seconds after entry of the 7th digit and then 'cuts-through' the call, connecting the mobile to the land line.

  If the local area code does not have any exchanges with a 0 or 1 in the 2nd digit position. or if 1+ dialing is not used, be sure to leave the exchange rate for exchange 300 = TOLL (15,15). Doing this allows for the automatic identification, by the interconnect unit, of local or long distance calls.

3.2 LAIR COMMAND
(Refer to Figure 19.)

The LAIR command provides the system manager with a list of parameters that are used by the CIT to calculate airtime charges for interconnect call types. These parameters were previously entered with the INIT command. CONTROL–X suspends the output and returns control to the billing prompt.

- System number – 153B is replaced with the actual number of the system.
- Method – Flat or Variable.
- Start date – Day of the month that the billing period for airtime begins (1–28).
- Minimum fee – Basic airtime charge each user pays irrespective of actual airtime used ($0.00–$999.99).
- Free minutes – Airtime period which is covered by the minimum fee charge (0–999).
- Airtime rate – Up to 6 per minute airtime rates that range in value from $0.00 to $9.99 can be specified.
- Weekday rate numbers – For each hour of a weekday (Monday through Friday) an airtime rate from 1–6 is specified. The actual value of this rate (1–6) is specified in the airtime rate table.
- Weekend rate numbers – For each hour of a weekend day (Saturday and Sunday) an airtime rate from 1–6 is specified. The actual value of this rate (1–6) is specified in the airtime rate table.
- Airtime tax rate – Tax rate to be applied to airtime charges.

```
 GRD> BILL(CR)
BILL> LAIR(CR)
THIS IS THE AIRTIME BILLING INFO FOR SYSTEM 153B
METHOD IS VARIABLE
START DATE-   15
MINIMUM FEE-$    5.00
FREE MINUTES -   5
AIRTIME RATE 1-$     .05
AIRTIME RATE 2-$     .10
AIRTIME RATE 3-$     .25
AIRTIME RATE 4-$     .85
AIRTIME RATE 5-$    1.95
AIRTIME RATE 6-$     .00
WEEKDAY RATE NUMBERS
HOUR     0    1
HOUR     1    1
HOUR     2    1
HOUR     3    1
HOUR     4    1
HOUR     5    1
HOUR     6    2
....
....
....
HOUR    22    1
HOUR    23    1
WEEKEND RATE NUMBERS

HOUR     0    6
HOUR     1    6
HOUR     2    6
HOUR     3    1
....
....
....
HOUR    22    6
HOUR    23    6
AIRTIME TAX RATE-    5.00%
BILL> Q(CR)

 GRD>
```

Figure 19. LAIR Command Example

3.3 LTEL COMMAND

(Refer to Figure 20.)

- The LTEL command provides the system manager with a list of parameters that are used by the CIT to calculate TELCO charges for interconnect call types. These parameters were previously entered using the INIT command. CONTROL–X suspends the output and returns control to the billing prompt.
- System number – 153B is replaced with the actual number for the system.
- Method – Flat, Metered or Variable.
- Start date – day of the month that the billing period for the TELCO charges begin (1–28).
- Fixed monthly fee – Monthly TELCO charges for basic phone line termination ($0–9999.99).
- Local call limit – Up to 4 local call limit levels can be specified. Each authorized user is assigned a call limit level from 1–4. A user who exceeds the assigned call limit level will not be allowed to make further calls until the call limit level is increased ($0–999.99).
- Unit charge – TELCO charges assigned to a unit which is defined to
- be a measure of telephone service used in the calculation of charges for dialed local calls. Phone exchange and the length of the call determine the number of units charged.
- Federal, State and Local tax – Tax rates to be applied to TELCO charges.
- Initial billing period – The minimum billing period in minutes used by the TELCO office to calculate charges for local calls. For example, a 1 minute local

```
 GRD> BILL(CR)
BILL> LTEL(CR)
THIS IS THE TELCO BILLING INFO FOR SYSTEM 153B
METHOD-VARIABLE
START DATE-  1
FIXED MONTHLY FEE $  75.00
LOCAL CALL LIMIT: LEVEL    1-$  10.00
LOCAL CALL LIMIT: LEVEL    2-$  50.00
LOCAL CALL LIMIT: LEVEL    3-$ 100.00
LOCAL CALL LIMIT: LEVEL    4-$ 999.00
UNIT CHARGE   5.29 CENTS
FEDERAL TAX   1.00%
STATE TAX     2.00%
LOCAL TAX     3.15%
INITIAL BILLING TIME PERIOD (MIN)   3
THEREAFTER TIME PERIOD (MIN) FOR INITIAL UNIT CHARGE OF    0   2
THEREAFTER TIME PERIOD (MIN) FOR INITIAL UNIT CHARGE OF    1   2
THEREAFTER TIME PERIOD (MIN) FOR INITIAL UNIT CHARGE OF    2   2
THEREAFTER TIME PERIOD (MIN) FOR INITIAL UNIT CHARGE OF    3   2
THEREAFTER TIME PERIOD (MIN) FOR INITIAL UNIT CHARGE OF    4   1
THEREAFTER TIME PERIOD (MIN) FOR INITIAL UNIT CHARGE OF    5   1
THEREAFTER TIME PERIOD (MIN) FOR INITIAL UNIT CHARGE OF    6   1
THEREAFTER TIME PERIOD (MIN) FOR INITIAL UNIT CHARGE OF    7   1
THEREAFTER TIME PERIOD (MIN) FOR INITIAL UNIT CHARGE OF    8   1
THEREAFTER TIME PERIOD (MIN) FOR INITIAL UNIT CHARGE OF    9   1
THEREAFTER TIME PERIOD (MIN) FOR INITIAL UNIT CHARGE OF   10   1
THEREAFTER TIME PERIOD (MIN) FOR INITIAL UNIT CHARGE OF   11   1
THEREAFTER TIME PERIOD (MIN) FOR INITIAL UNIT CHARGE OF   12   1
THEREAFTER TIME PERIOD (MIN) FOR INITIAL UNIT CHARGE OF   13   1
THEREAFTER TIME PERIOD (MIN) FOR INITIAL UNIT CHARGE OF   14   1
THEREAFTER TIME PERIOD (MIN) FOR INITIAL UNIT CHARGE OF   15   1
BILL> (CR)

 GRD>
```

Figure 20. LTEL Command Example

call to a TELCO office with a 3 minute minimum is billed as a 3 minute call

- Thereafter time period – The minimum billing period in minutes for that time in excess of the initial billing period used by the TELCO office to calculate charges for local calls. The minimum billing period may vary depending on the distance of the exchange called. The multiple entry table provides the required flexibility (0–9 minutes).

3.4 LEXC COMMAND

(Refer to Figure 21.)

The LEXC command provides the system manager with a list of TELCO exchange rates that are used by t he CIT to calculate TELCO charges or local interconnect call types. These parameters were previously entered using the INIT command. CONTROL–X suspends the output and returns control to the billing prompt.

- Area Code (i.e., 312) – Area code of the TELCO office that provides phone line service to the CIT terminal. The area code changes depending on system location.

- Federal, State Local tax – YES - tax is to be included in the calculation of charges, NO – tax is ignored. The actual tax rates can be listed with the LTEL command.

- Local exchange rates – Listing of the units for all possible TELCO exchanges from 200 to 999 for local calls. For example, the unit rate for exchange 203 is 06,02. The 06 specifies the number of units charges for the initial billing time period. The 02 specifies the number of units charged for the thereafter time periods. The unit charge, initial billing time period, and thereafter time period can be listed with the LTEL command. A unit rate of 15,15 is a default value that specifies the exchange is a toll call exchange.

- Area code (i.e., 414, 815) – The exchanges listed for these area codes are treated as local calls for billing purposes by the TELCO office.

```
 GRD> BILL(CR)
BILL> LEXC(CR)
THIS IS THE EXCHANGE RATE INFO FOR SYSTEM 153B
AREA CODE - 312
FEDERAL TAX  YES
STATE TAX  NO
LOCAL TAX  NO
LOCAL AREA CODE EXCHANGE RATES:

EXCH  0     1     2     3     4     5     6     7     8     9
--------------------------------------------------------------------------
200 03,01 02,01 03,01 06,02 01,01 00,00 02,01 03,01 10,02 15,05
210 09,03 03,01 04,02 00,00 04,01 06,02 01,00 01,01 00,00 00,00
....
....
....
990 01,01 03,01 09,02 10,01 12,02 02,01 04,01 01,00 00,00 00,00

END OF RETRIEVAL

AREA CODE - 414
FEDERAL TAX  YES
STATE TAX  NO
LOCAL TAX  NO
EXCHANGE RATES -
576 01,00
872 06,00
415 04,01
690 01,01

END OF RETRIEVAL

AREA CODE - 815
FEDERAL TAX  YES
STATE TAX  NO
LOCAL TAX  NO
EXCHANGE RATES -
892 03, 01
668 02,01

END OF RETRIEVAL

BILL> (CR)

 GRD>
```

Figure 21. LEXC Command Example

3.5 MAIR COMMAND

(Refer to Figure 22.)

The MAIR command provides the system manager with the means to modify airtime billing parameters. These parameters were previously entered with the INIT command. For each parameter line output: entering a (CR) leaves the parameter unchanged; entering a data stream modifies the parameter; or entering Q exits the routine and returns to the billing prompt. The changes can be verified with the LAIR command.

In the example, the method, start date, free minutes, airtime rate 4, weekday hour 4, and weekday hour 6 parameters remain unchanged. The other parameters were changed as indicated.

3.6 MTEL COMMAND

(Refer to Figure 23.)

The MTEL command provides the system manager with the means to modify TELCO billing parameters. These parameters were previously entered with the INIT command. For each parameter line output, entering a (CR) leaves the parameter unchanged; entering a data stream to modifies the parameter; or entering Q exits the routine and returns to the billing prompt. The changes can be verified with the LTEL command.

```
 GRD> BILL(CR)

BILL> MAIR(CR)
THIS IS THE AIRTIME BILLING INFO FOR SYSTEM 153B
METHOD-VARIABLE: (CR)
START DATE-   1: (CR)
MINIMUM FEE-$   7.50  8.00(CR
FREE MINUTES -   6: (CR)
AIRTIME RATE 1-$     .25: .00(CR)
AIRTIME RATE 2-$     .35: .25(CR)
AIRTIME RATE 3-$     .45: .35(CR)
AIRTIME RATE 4-$     .55: (CR)
AIRTIME RATE 5-$     .75: .85(CR)
AIRTIME RATE 6-$     .00: 1.00(CR)
WEEKDAY RATE NUMBERS

HOUR    0   6: 1(CR)
HOUR    1   6: 1(CR)
HOUR    2   6: 1(CR)
HOUR    3   6: 2(CR)
HOUR    4   2: (CR)
HOUR    5   3: 2(CR)
HOUR    6   2: Q(CR)
BILL> Q(CR)

 GRD>
```

Figure 22. MAIR Command Example

```
 GRD> BILL(CR)

BILL> MTEL(CR)
THIS IS THE AIRTIME BILLING INFO FOR SYSTEM 153B
METHOD-VARIABLE:
START DATE-   1:
FIXED MONTHLY FEE $  67.29:
LOCAL CALL LIMIT: LEVEL    1-$   8.00: (CR)
LOCAL CALL LIMIT: LEVEL    2-$  25.00: (CR)
LOCAL CALL LIMIT: LEVEL    3-$ 100.00: 50.00(CR)
LOCAL CALL LIMIT: LEVEL    4-$ 999.00: 75.00(CR)
UNIT CHARGE    5.29 CENTS (CR)
FEDERAL TAX   1.00%: (CR)
STATE TAX     2.00%: (CR)
LOCAL TAX     3.20%: (CR)
INITIAL BILLING TIME PERIOD (MIN)   3 (CR)
THEREAFTER TIME PERIOD (MIN) FOR INITIAL UNIT CHARGE OF    0  1: 2(CR)
THEREAFTER TIME PERIOD (MIN) FOR INITIAL UNIT CHARGE OF    1  2: (CR)
THEREAFTER TIME PERIOD (MIN) FOR INITIAL UNIT CHARGE OF    2  2: 1(CR)
THEREAFTER TIME PERIOD (MIN) FOR INITIAL UNIT CHARGE OF    3  2: Q(CR)
BILL> Q(CR)

 GRD>
```

Figure 23. MTEL Command Example

In the example, the method, start date, local call limit levels 1 and 2, unit charge, federal and state tax, initial billing time period, and thereafter time period for initial unit charge of 1 and 3 minutes remain unchanged. The other parameters were changed a indicated.

3.7 MEXC COMMAND
(Refer to Figure 24.)

The MEXC command provides the system manager with the means to modify exchange rate billing parameters.

These parameters were previously entered with the INIT command. For each parameter line output: entering a (CR) leaves the parameter unchanged; entering a data stream modifies the parameter, or entering Q exits the routine and returns to the billing prompt. The changes can be verified with the LEXC command.

Each exchange to be modified in the local area code must be specified. Entering a (CR) after 'INITIAL UNITS (XX)?' or 'THEREAFTER UNITS (XX)?' will result in the parameter being unchanged. Entering a (CR) after an 'EXCHANGE (XXX)?' in the local area code causes the program to advance to the nearby area code exchanges. Modification of an exchange in the nearby area code is accomplished by cycling through all the exchanges for each of the nearby area code. Entering a Q causes the routine to exit to the billing prompt.

3.8 AEXC COMMAND
(Refer to Figure 25, Figure 26, and Figure 27.)

The AEXC command allows the system manager to add additional exchanges and nearby area codes to the TELCO billing exchange tables. The INIT command was used by the system manager to initially create the exchange tables. The following examples demonstrate the use of this command.

The Figure 25 example applies to a system that has been set up for a flat TELCO billing method. Free exchanges 333 and 576 were added to the 312 area code exchange list, and exchange 344 was added to the 815 list.

The Figure 26 example applies to a system that has been set up for a metered TELCO billing method and shows the addition of exchanges for a new area code. Entering a (CR) after ' 'EXCHANGE (XXX)?' causes the program to advance to the next step of requesting additional area codes.. Entering a new area code results in prompts for taxes. Entering a (CR) after ENTER AREA CODE (XXX)? causes the program to exit to the billing prompt. Entering a Q after any prompt causes the program to exit to the billing prompt.

The Figure 27 example applies to a system that has been set up for a variable TELCO billing method.

NOTE

The maximum number of units that can be specified for initial and thereafter time periods is 15. The minimum is 0 (zero).

3.9 DEXC COMMAND
(Refer to Figure 28.)

The DEXC command allows deletion of entire area codes (excluding the local area code) or specific exchanges (excluding exchanges within the local area code table) from the billing exchange tables. T he MEXC command is used to delete or modify exchanges for the local area code.

Exchange 344 is deleted from area code 815 in this example. Answering Y to the question DO YOU WISH TO DELETE THIS AREA CODE (Y/N)? would have resulted in all exchanges for area code 815 being deleted. Entering a (CR) after 'EXCHANGE (XXX)?' causes the program to advance to the next step of requesting additional area codes. Entering a (CR) after ENTER AREA CODE? (XXX) causes the program to exit to the billing prompt. Entering a Q causes the program to exit to the billing prompt.

3.10 SAIR COMMAND
(Refer to Figure 29.)

The SAIR command provides a listing of airtime charges for the current or previous billing periods. A prompt provides the choice of specifying the listing of airtime charges for the entire system, for a talk group ID, for a unit or range of units, or customer group. CONTROL–X suspends the output and returns control to the billing prompt BILL>. Entering a Q for a billing period returns control to the billing prompt.

- System number – 153B is replaced with the actual number for the system.
- Billing period – L = billing period for the previous month, T = current billing period up to the current day.
- GROUP, TYPE II ID RANGE, ID, TALK GP, FLT IND, OR ALL Gxxx, Ixxxxxx–Ixxxxxx, Ixxxxxx, Txxxxxx, xxx xxx, OR (CR) – Enter a group number for information about an entire group, a range of Type II unit IDs to inclusively list only a portion of the IDs, a specific unit ID, a talk group I D for a specific talk group, an individual ID for a specific fleet, or, a (CR). A (CR) results in all applicable units and talk groups being listed.
- Airtime – The actual airtime in minutes and seconds for interconnect type call types for the billing period.

```
 GRD> BILL(CR)

BILL> MAIR(CR)
THIS IS THE AIRTIME BILLING INFO FOR SYSTEM 153B
METHOD-VARIABLE: (CR)
START DATE-   1: (CR)
MINIMUM FEE-$   7.50  8.00(CR)
FREE MINUTES -   6: (CR)
AIRTIME RATE 1-$    .25: .00(CR)
AIRTIME RATE 2-$    .35: .25(CR)
AIRTIME RATE 3-$    .45: .35(CR)
AIRTIME RATE 4-$    .55: (CR)
AIRTIME RATE 5-$    .75: .85(CR)
AIRTIME RATE 6-$    .00: 1.00(CR)
WEEKDAY RATE NUMBERS

HOUR    0   6: 1(CR)
HOUR    1   6: 1(CR)
HOUR    2   6: 1(CR)
HOUR    3   6: 2(CR)
HOUR    4   2: (CR)
HOUR    5   3: 2(CR)
HOUR    6   2: Q(CR)
BILL> Q(CR)

 GRD>
```

Figure 22. MAIR Command Example

```
 GRD> BILL(CR)

BILL> MTEL(CR)
THIS IS THE AIRTIME BILLING INFO FOR SYSTEM 153B
METHOD-VARIABLE:
START DATE-   1:
FIXED MONTHLY FEE $  67.29:
LOCAL CALL LIMIT: LEVEL    1-$   8.00: (CR)
LOCAL CALL LIMIT: LEVEL    2-$  25.00: (CR)
LOCAL CALL LIMIT: LEVEL    3-$ 100.00: 50.00(CR)
LOCAL CALL LIMIT: LEVEL    4-$ 999.00: 75.00(CR)
UNIT CHARGE    5.29 CENTS (CR)
FEDERAL TAX   1.00%: (CR)
STATE TAX     2.00%: (CR)
LOCAL TAX     3.20%: (CR)
INITIAL BILLING TIME PERIOD (MIN)   3 (CR)
THEREAFTER TIME PERIOD (MIN) FOR INITIAL UNIT CHARGE OF    0  1: 2(CR)
THEREAFTER TIME PERIOD (MIN) FOR INITIAL UNIT CHARGE OF    1  2: (CR)
THEREAFTER TIME PERIOD (MIN) FOR INITIAL UNIT CHARGE OF    2  2: 1(CR)
THEREAFTER TIME PERIOD (MIN) FOR INITIAL UNIT CHARGE OF    3  2: Q(CR)
BILL> Q(CR)

 GRD>
```

Figure 23. MTEL Command Example

In the example, the method, start date, local call limit levels 1 and 2, unit charge, federal and state tax, initial billing time period, and thereafter time period for initial unit charge of 1 and 3 minutes remain unchanged. The other parameters were changed a indicated.

3.7 MEXC COMMAND
(Refer to Figure 24.)

The MEXC command provides the system manager with the means to modify exchange rate billing parameters.

These parameters were previously entered with the INIT command. For each parameter line output: entering a (CR) leaves the parameter unchanged; entering a data stream modifies the parameter, or entering Q exits the routine and returns to the billing prompt. The changes can be verified with the LEXC command.

Each exchange to be modified in the local area code must be specified. Entering a (CR) after 'INITIAL UNITS (XX)?' or 'THEREAFTER UNITS (XX)?' will result in the parameter being unchanged. Entering a (CR) after an 'EXCHANGE (XXX)?' in the local area code causes the program to advance to the nearby area code exchanges. Modification of an exchange in the nearby area code is accomplished by cycling through all the exchanges for each of the nearby area code. Entering a Q causes the routine to exit to the billing prompt.

3.8 AEXC COMMAND
(Refer to Figure 25, Figure 26, and Figure 27.)

The AEXC command allows the system manager to add additional exchanges and nearby area codes to the TELCO billing exchange tables. The INIT command was used by the system manager to initially create the exchange tables. The following examples demonstrate the use of this command.

The Figure 25 example applies to a system that has been set up for a flat TELCO billing method. Free exchanges 333 and 576 were added to the 312 area code exchange list, and exchange 344 was added to the 815 list.

The Figure 26 example applies to a system that has been set up for a metered TELCO billing method and shows the addition of exchanges for a new area code. Entering a (CR) after ' 'EXCHANGE (XXX)?' causes the program to advance to the next step of requesting additional area codes.. Entering a new area code results in prompts for taxes. Entering a (CR) after ENTER AREA CODE (XXX)? causes the program to exit to the billing prompt. Entering a Q after any prompt causes the program to exit to the billing prompt.

The Figure 27 example applies to a system that has been set up for a variable TELCO billing method.

NOTE

> The maximum number of units that can be specified for initial and thereafter time periods is 15. The minimum is 0 (zero).

3.9 DEXC COMMAND
(Refer to Figure 28.)

The DEXC command allows deletion of entire area codes (excluding the local area code) or specific exchanges (excluding exchanges within the local area code table) from the billing exchange tables. T he MEXC command is used to delete or modify exchanges for the local area code.

Exchange 344 is deleted from area code 815 in this example. Answering Y to the question DO YOU WISH TO DELETE THIS AREA CODE (Y/N)? would have resulted in all exchanges for area code 815 being deleted. Entering a (CR) after 'EXCHANGE (XXX)?' causes the program to advance to the next step of requesting additional area codes. Entering a (CR) after ENTER AREA CODE? (XXX) causes the program to exit to the billing prompt. Entering a Q causes the program to exit to the billing prompt.

3.10 SAIR COMMAND
(Refer to Figure 29.)

The SAIR command provides a listing of airtime charges for the current or previous billing periods. A prompt provides the choice of specifying the listing of airtime charges for the entire system, for a talk group ID, for a unit or range of units, or customer group. CONTROL-X suspends the output and returns control to the billing prompt BILL>. Entering a Q for a billing period returns control to the billing prompt.

- System number – 153B is replaced with the actual number for the system.
- Billing period – L = billing period for the previous month, T = current billing period up to the current day.
- GROUP, TYPE II ID RANGE, ID, TALK GP, FLT IND, OR ALL Gxxx, Ixxxxxx–Ixxxxxx, Ixxxxxx, Txxxxxx, xxx xxx, OR (CR) – Enter a group number for information about an entire group, a range of Type II unit IDs to inclusively list only a portion of the IDs, a specific unit ID, a talk group I D for a specific talk group, an individual ID for a specific fleet, or, a (CR). A (CR) results in all applicable units and talk groups being listed.
- Airtime – The actual airtime in minutes and seconds for interconnect type call types for the billing period.

```
 GRD> BILL(CR)

BILL> MAIR(CR)
THIS IS THE AIRTIME BILLING INFO FOR SYSTEM 153B
METHOD-VARIABLE: (CR)
START DATE-    1: (CR)
MINIMUM FEE-$    7.50  8.00(CR
FREE MINUTES -    6: (CR)
AIRTIME RATE 1-$     .25: .00(CR)
AIRTIME RATE 2-$     .35: .25(CR)
AIRTIME RATE 3-$     .45: .35(CR)
AIRTIME RATE 4-$     .55: (CR)
AIRTIME RATE 5-$     .75: .85(CR)
AIRTIME RATE 6-$     .00: 1.00(CR)
WEEKDAY RATE NUMBERS

HOUR    0   6: 1(CR)
HOUR    1   6: 1(CR)
HOUR    2   6: 1(CR)
HOUR    3   6: 2(CR)
HOUR    4   2: (CR)
HOUR    5   3: 2(CR)
HOUR    6   2: Q(CR)
BILL> Q(CR)

 GRD>
```

Figure 22. MAIR Command Example

```
 GRD> BILL(CR)

BILL> MTEL(CR)
THIS IS THE AIRTIME BILLING INFO FOR SYSTEM 153B
METHOD-VARIABLE:
START DATE-    1:
FIXED MONTHLY FEE $  67.29:
LOCAL CALL LIMIT: LEVEL    1-$   8.00: (CR)
LOCAL CALL LIMIT: LEVEL    2-$  25.00: (CR)
LOCAL CALL LIMIT: LEVEL    3-$ 100.00: 50.00(CR)
LOCAL CALL LIMIT: LEVEL    4-$ 999.00: 75.00(CR)
UNIT CHARGE     5.29 CENTS (CR)
FEDERAL TAX    1.00%: (CR)
STATE TAX      2.00%: (CR)
LOCAL TAX      3.20%: (CR)
INITIAL BILLING TIME PERIOD (MIN)   3 (CR)
THEREAFTER TIME PERIOD (MIN) FOR INITIAL UNIT CHARGE OF    0  1: 2(CR)
THEREAFTER TIME PERIOD (MIN) FOR INITIAL UNIT CHARGE OF    1  2: (CR)
THEREAFTER TIME PERIOD (MIN) FOR INITIAL UNIT CHARGE OF    2  2: 1(CR)
THEREAFTER TIME PERIOD (MIN) FOR INITIAL UNIT CHARGE OF    3  2: Q(CR)
BILL> Q(CR)

 GRD>
```

Figure 23. MTEL Command Example

In the example, the method, start date, local call limit levels 1 and 2, unit charge, federal and state tax, initial billing time period, and thereafter time period for initial unit charge of 1 and 3 minutes remain unchanged. The other parameters were changed a indicated.

3.7 MEXC COMMAND
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The MEXC command provides the system manager with the means to modify exchange rate billing parameters.

These parameters were previously entered with the INIT command. For each parameter line output: entering a (CR) leaves the parameter unchanged; entering a data stream modifies the parameter, or entering Q exits the routine and returns to the billing prompt. The changes can be verified with the LEXC command.

Each exchange to be modified in the local area code must be specified. Entering a (CR) after 'INITIAL UNITS (XX)?' or 'THEREAFTER UNITS (XX)?' will result in the parameter being unchanged. Entering a (CR) after an 'EXCHANGE (XXX)?' in the local area code causes the program to advance to the nearby area code exchanges. Modification of an exchange in the nearby area code is accomplished by cycling through all the exchanges for each of the nearby area code. Entering a Q causes the routine to exit to the billing prompt.

3.8 AEXC COMMAND
(Refer to Figure 25, Figure 26, and Figure 27.)

The AEXC command allows the system manager to add additional exchanges and nearby area codes to the TELCO billing exchange tables. The INIT command was used by the system manager to initially create the exchange tables. The following examples demonstrate the use of this command.

The Figure 25 example applies to a system that has been set up for a flat TELCO billing method. Free exchanges 333 and 576 were added to the 312 area code exchange list, and exchange 344 was added to the 815 list.

The Figure 26 example applies to a system that has been set up for a metered TELCO billing method and shows the addition of exchanges for a new area code. Entering a (CR) after ' 'EXCHANGE (XXX)?' causes the program to advance to the next step of requesting additional area codes.. Entering a new area code results in prompts for taxes. Entering a (CR) after ENTER AREA CODE (XXX)? causes the program to exit to the billing prompt. Entering a Q after any prompt causes the program to exit to the billing prompt.

The Figure 27 example applies to a system that has been set up for a variable TELCO billing method.

NOTE

The maximum number of units that can be specified for initial and thereafter time periods is 15. The minimum is 0 (zero).

3.9 DEXC COMMAND
(Refer to Figure 28.)

The DEXC command allows deletion of entire area codes (excluding the local area code) or specific exchanges (excluding exchanges within the local area code table) from the billing exchange tables. T he MEXC command is used to delete or modify exchanges for the local area code.

Exchange 344 is deleted from area code 815 in this example. Answering Y to the question DO YOU WISH TO DELETE THIS AREA CODE (Y/N)? would have resulted in all exchanges for area code 815 being deleted. Entering a (CR) after 'EXCHANGE (XXX)?' causes the program to advance to the next step of requesting additional area codes. Entering a (CR) after ENTER AREA CODE? (XXX) causes the program to exit to the billing prompt. Entering a Q causes the program to exit to the billing prompt.

3.10 SAIR COMMAND
(Refer to Figure 29.)

The SAIR command provides a listing of airtime charges for the current or previous billing periods. A prompt provides the choice of specifying the listing of airtime charges for the entire system, for a talk group ID, for a unit or range of units, or customer group. CONTROL-X suspends the output and returns control to the billing prompt BILL>. Entering a Q for a billing period returns control to the billing prompt.

- System number – 153B is replaced with the actual number for the system.
- Billing period – L = billing period for the previous month, T = current billing period up to the current day.
- GROUP, TYPE II ID RANGE, ID, TALK GP, FLT IND, OR ALL Gxxx, Ixxxxxx–Ixxxxxx, Ixxxxxx, Txxxxxx, xxx xxx, OR (CR) – Enter a group number for information about an entire group, a range of Type II unit IDs to inclusively list only a portion of the IDs, a specific unit ID, a talk group I D for a specific talk group, an individual ID for a specific fleet, or, a (CR). A (CR) results in all applicable units and talk groups being listed.
- Airtime – The actual airtime in minutes and seconds for interconnect type call types for the billing period.

```
 GRD> BILL(CR)

BILL> MTEL(CR)
THIS IS THE EXCHANGE RATE INFO FOR SYSTEM 153B
AREA CODE - 312: (CR)
FEDERAL TAX  NO: (CR)
STATE TAX  NO: (CR)
LOCAL TAX  NO: (CR)
LOCAL AREA CODE EXCHANGE RATE MODIFICATIONS -
ENTER EXCHANGE TO MODIFY OR JUST HIT RETURN TO QUIT
IF PRESENT EXCHANGE IS CORRECT, JUST HIT RETURN, ELSE ENTER NEW RATE
EXCHANGE (XXX)? 809(CR)
08,09
INITIAL UNITS (XX): (CR)
THEREAFTER UNITS (XX): (CR)
EXCHANGE (XXX)? 456(CR)
15,15
INITIAL UNITS (XX): (CR)
THEREAFTER UNITS (XX): (CR)
EXCHANGE (XXX)? 201(CR)
02,01
INITIAL UNITS (XX): (CR)
THEREAFTER UNITS (XX): (CR)
EXCHANGE (XXX)? (CR)

END OF RETRIEVAL

NEARBY AREA CODE EXCHANGE RATE MODIFICATIONS -
IF PRESENT EXCHANGE RATE IS CORRECT, JUST HIT RETURN, ELSE ENTER NEW RATE
AREA CODE 1- 815:
FEDERAL TAX  YES: (CR)
STATE TAX  YES: (CR)
LOCAL TAX  YES: (CR)
EXCHANGE RATE -
455 00,00
INITIAL UNITS (XX): (CR)
THEREAFTER UNITS (XX): (CR)
459 00,00
INITIAL UNITS (XX): (CR)
THEREAFTER UNITS (XX): (CR)

END OF RETRIEVAL

AREA CODE - 414: (CR)
FEDERAL TAX  YES: (CR)
STATE TAX  YES: (CR)
LOCAL TAX  YES: (CR)
EXCHANGE RATE -
455 09,09
INITIAL UNITS (XX): (CR)
THEREAFTER UNITS (XX): (CR)

END OF RETRIEVAL
BILL> Q(CR)

 GRD>
```

Figure 24. MEXC Command Example

```
 GRD> BILL(CR)

BILL> AEXC(CR)
ENTER AREA CODE (XXX)? 312(CR)
ENTER ALL EXCHANGES WITHIN THIS AREA CODE.
HIT (CR) TO QUIT
EXCHANGE (XXX): 333(CR)
INITIAL UNITS (XX)? 1(CR)
THEREAFTER UNITS (XX)? 1(CR)
EXCHANGE (XXX): 576(CR)
INITIAL UNITS (XX)? 1(CR)
THEREAFTER UNITS (XX)? 1(CR)
EXCHANGE (XXX): (CR)
ENTER AREA CODE (XXX)? 815(CR)
ENTER NONTOLL EXCHANGES AND THEIR RATES FOR THIS AREA CODE.
HIT (CR) TO QUIT
EXCHANGE (XXX): 344(CR)
INITIAL UNITS (XX)? 1(CR)
THEREAFTER UNITS (XX)? 1(CR)
EXCHANGE (XXX): (CR)
ENTER AREA CODE (XXX)? (CR)
BILL> Q(CR)

 GRD>
```

Figure 25. AEXC Command, Flat TELCO Billing Method Example

```
 GRD> BILL(CR)

BILL> AEXC(CR)
ENTER AREA CODE (XXX)? 312(CR)
ENTER ALL FREE EXCHANGES WITHIN THIS AREA CODE.
ENTER CR TO QUIT.
EXCHANGE (XXX)? 333(CR)
EXCHANGE (XXX)? 576(CR)
EXCHANGE (XXX)? (CR)
ENTER ALL METERED EXCHANGES WITHIN THIS AREA CODE.
ENTER CR TO QUIT.
EXCHANGE (XXX)? 523(CR)
EXCHANGE (XXX)? (CR)
ENTER AREA CODE (XXX)? 414(CR)
FEDERAL TAX ON CALLS TO THIS AREA CODE (Y/N)? Y(CR)
STATE TAX ON CALLS TO THIS AREA CODE (Y/N)? N(CR)
LOCAL TAX ON CALLS TO THIS AREA CODE (Y/N)? Y(CR)
ENTER ALL FREE EXCHANGES WITHIN THIS AREA CODE.
ENTER CR TO QUIT.
EXCHANGE (XXX)? 456(CR)
EXCHANGE (XXX)? (CR)
ENTER ALL METERED EXCHANGES WITHIN THIS AREA CODE.
ENTER CR TO QUIT.
EXCHANGE (XXX)? 690(CR)
EXCHANGE (XXX)? 657(CR)
EXCHANGE (XXX)? (CR)
ENTER AREA CODE (XXX)? (CR)
BILL> Q(CR)

 GRD>
```

Figure 26. AEXC Command, Metered TELCO Billing Method Example

```
 GRD> BILL(CR)

BILL> AEXC(CR)
ENTER AREA CODE (XXX)? 312(CR)
ENTER ALL EXCHANGES WITHIN THIS AREA CODE.
HIT (CR) TO QUIT.
EXCHANGE (XXX)? 453(CR)
INITIAL UNITS (XX)? 3(CR)
THEREAFTER UNITS (XX)? 4(CR)
EXCHANGE (XXX)? (CR)
ENTER AREA CODE (XXX)? 303(CR)
FEDERAL TAX ON CALLS TO THIS AREA CODE (Y/N)? Y(CR)
STATE TAX ON CALLS TO THIS AREA CODE (Y/N)? N(CR)
LOCAL TAX ON CALLS TO THIS AREA CODE (Y/N)? Y(CR)
ENTER NONTOLL EXCHANGES AND THEIR RATES FOR THIS AREA CODE. HIT (CR) TO QUIT.
EXCHANGE (XXX)? 456(CR)
INITIAL UNITS (XX)? 12(CR)
THEREAFTER UNITS (XX)? 3(CR)
EXCHANGE (XXX)? (CR)
ENTER AREA CODE (XXX)? (CR)
BILL> Q(CR)

 GRD>
```

Figure 27. AEXC Command, Variable TELCO Billing Method Example

```
 GRD> BILL(CR)

BILL> DEXC(CR)
ENTER AREA CODE (XXX)? 815(CR)
DELETE THIS AREA CODE (Y/N)? N(CR)
EXCHANGE (XXX)? 344(CR)
EXCHANGE (XXX)? (CR)
ENTER AREA CODE (XXX)? (CR)
BILL> Q(CR)

 GRD>
```

Figure 28. DEXC Command Example

- Fixed charge – Fixed airtime charge independent of airtime used.
- Additional charge – Airtime charges that were calculated by the CIT based upon airtime used, time of day and day of week.

NOTE

The airtime charges for the previous billing period are saved for an entire billing

NOTE (Cont'd.)

period. For example, the charges calculated for the period of 5–1 to 6–1 are saved until the date of 7–1.

NOTE

With Option D610, airtime for *Coverage-PLUS* roaming units is not listed.

```
 GRD> BILL(CR)

BILL> SAIR(CR)
BILLING PERIOD (THIS/LAST) ? T(CR)
GROUP, TYPE II ID RANGE, ID, TALK GP, FLT IND, OR ALL
Gxxx, Ixxxxxx-Ixxxxxx, Ixxxxxx, Txxxxxx, xxx xxx, OR (CR): I757345-I757349(CR)

AIRTIME CHARGE FROM  1- 1 THRU  1-15 FOR ID I757345-I757349 FOR SYSTEM 0B05
------------------------------------------------------------------------------
CUSTOMER UNIT   AIRTIME    FIXED   ADDITIONAL
  GROUP    ID   MIN.SEC    CHARGE    CHARGE      TAX      TOTAL
------------------------------------------------------------------------------
   100  I757345       .00    1.99         .00     .03         2.02
   100  I757346       .00    1.99         .00     .03         2.02
   100  I757347       .00    1.99         .00     .03         2.02
   100  I757348       .00    1.99         .00     .03         2.02
   100  I757349      7.43    1.99        7.67     .19         9.85
------------------------------------------------------------------------------

BILL> SAIR(CR)
BILLING PERIOD (THIS/LAST) ? T(CR)
GROUP, TYPE II ID RANGE, ID, TALK GP, FLT IND, OR ALL
Gxxx, Ixxxxxx-Ixxxxxx, Ixxxxxx, Txxxxxx, xxx xxx, OR (CR): 600 1 (CR)

AIRTIME CHARGE FROM  1- 1 THRU  1-15 FOR ID 0001 FOR SYSTEM 0B05
------------------------------------------------------------------------------
CUSTOMER UNIT   AIRTIME    FIXED   ADDITIONAL
  GROUP    ID   MIN.SEC    CHARGE    CHARGE      TAX      TOTAL
------------------------------------------------------------------------------
   600    001         .00    1.99         .00     .03         2.02

BILL> SAIR(CR)
BILLING PERIOD (THIS/LAST) ? T(CR)
GROUP, TYPE II ID RANGE, ID, TALK GP, FLT IND, OR ALL
Gxxx, Ixxxxxx-Ixxxxxx, Ixxxxxx, Txxxxxx, xxx xxx, OR (CR): G200 (CR)
NOT ON GROUP LIST
BILL>
```

Figure 29. SAIR Command Example (Sheet 1 of 3)

```
BILL> SAIR(CR)
BILLING PERIOD (THIS/LAST) ? T(CR)
GROUP, TYPE II ID RANGE, ID, TALK GP, FLT IND, OR ALL
Gxxx, Ixxxxxx-Ixxxxxx, Ixxxxxx, Txxxxxx, xxx xxx, OR (CR): G1(CR)

AIRTIME CHARGE FROM  1- 1 THRU  1-15 FOR ID I757345-I757349 FOR SYSTEM 0B05
-----------------------------------------------------------------------------
CUSTOMER UNIT   AIRTIME    FIXED   ADDITIONAL
  GROUP   ID    MIN.SEC   CHARGE     CHARGE      TAX      TOTAL
-----------------------------------------------------------------------------
   001    001      3.26     1.99       3.42      .10        5.51
   001    002       .00     1.99        .00      .03        2.02
   001    027       .00     1.99        .00      .03        2.02
   001    028      5.51     1.99       5.81      .15        7.95
   001    02C       .00     1.99        .00      .03        2.02
   001    02D       .00     1.99        .00      .03        2.02
   001    02E       .00     1.99        .00      .03        2.02
   001    02F       .00     1.99        .00      .03        2.02
   001    030       .00     1.99        .00      .03        2.02
   001    031       .00     1.99        .00      .03        2.02
   001    032      7.43     1.99       7.67      .19        9.85
   001    033       .00     1.99        .00      .03        2.02
   001    034       .00     1.99        .00      .03        2.02
-----------------------------------------------------------------------------
          13      17.00    25.87      16.90      .74       43.51  GROUP TOTAL
BILL>
BILLING PERIOD (THIS/LAST) ? T(CR)
GROUP, TYPE II ID RANGE, ID, TALK GP, FLT IND, OR ALL
Gxxx, Ixxxxxx-Ixxxxxx, Ixxxxxx, Txxxxxx, xxx xxx, OR (CR): (CR)

AIRTIME CHARGE FROM  1- 1 THRU  1-15 FOR SYSTEM 0B05
-----------------------------------------------------------------------------
CUSTOMER UNIT   AIRTIME    FIXED   ADDITIONAL
  GROUP   ID    MIN.SEC   CHARGE     CHARGE      TAX      TOTAL
-----------------------------------------------------------------------------
   001    001      3.26     1.99       3.42      .10        5.51
   001    002       .00     1.99        .00      .03        2.02
   001    027       .00     1.99        .00      .03        2.02
   001    028      5.51     1.99       5.81      .15        7.95
   001    02C       .00     1.99        .00      .03        2.02
   001    02D       .00     1.99        .00      .03        2.02
   001    02E       .00     1.99        .00      .03        2.02
   001    02F       .00     1.99        .00      .03        2.02
   001    030       .00     1.99        .00      .03        2.02
   001    031       .00     1.99        .00      .03        2.02
   001    032      7.43     1.99       7.67      .19        9.85
   001    033       .00     1.99        .00      .03        2.02
   001    034       .00     1.99        .00      .03        2.02
-----------------------------------------------------------------------------
          13      17.00    25.87      16.90      .74       43.51  GROUP TOTAL

   100  I757355     .00     1.99        .00      .03        2.02
-----------------------------------------------------------------------------
           1        .00     1.99        .00      .03        2.02  GROUP TOTAL
```

Figure 29. SAIR Command Example (Sheet 2 of 3)

```
   600  I757356       .00    1.99         .00     .03          2.02
   600  I757357       .00    1.99         .00     .03          2.02
----------------------------------------------------------------------------
          2           .00    3.98         .00     .06          4.04   GROUP TOTAL

----------------------------------------------------------------------------
         16         17.00   31.84       16.90     .83         49.57   SYSTEM TOTAL
BILL> SAIR(CR)
BILLING PERIOD (THIS/LAST) ? L(CR)
GROUP, TYPE II ID RANGE, ID, TALK GP, FLT IND, OR ALL
Gxxx, Ixxxxxx-Ixxxxxx, Ixxxxxx, Txxxxxx, xxx xxx, OR (CR): (CR)

AIRTIME CHARGE FROM  7- 1 THRU  7-31 FOR SYSTEM 153B
----------------------------------------------------------------------------
CUSTOMER UNIT   AIRTIME    FIXED   ADDITIONAL
  GROUP   ID    MIN.SEC    CHARGE    CHARGE      TAX      TOTAL
----------------------------------------------------------------------------
   002     123     12.11     5.00        7.54     .10         12.64
   002     124      8.50     5.00        5.62     .08         10.70
   002     125     13.07     5.00        8.19     .11         13.30
   002  T800001     6.40     5.00        3.98     .05          9.03
----------------------------------------------------------------------------
          4         40.48   20.00       25.33     .34         45.67   GROUP TOTAL

   004  I757370     17.24    5.00       10.76     .14         15.90
----------------------------------------------------------------------------
          1         17.24    5.00       10.76     .14         15.90   GROUP TOTAL
----------------------------------------------------------------------------
          5         57.72   25.00       36.09     .48         61.57   SYSTEM TOTAL

BILL> SAIR(CR)
BILLING PERIOD (THIS/LAST) ? T(CR)
GROUP, TYPE II ID RANGE, ID, TALK GP, FLT IND, OR ALL
Gxxx, Ixxxxxx-Ixxxxxx, Ixxxxxx, Txxxxxx, xxx xxx, OR (CR): G3 (CR)

AIRTIME CHARGE FROM  8- 1 THRU  8-10 FOR SYSTEM 153B
----------------------------------------------------------------------------
CUSTOMER UNIT   AIRTIME    FIXED   ADDITIONAL
  GROUP   ID    MIN.SEC    CHARGE    CHARGE      TAX      TOTAL
----------------------------------------------------------------------------
   003     133      5.13     5.00        3.68     .06          8.74
   003     134      2.11     5.00        1.36     .03          6.39
   003  I7573111   18.34     5.00        9.74     .16         14.90
----------------------------------------------------------------------------
          3         26.07   15.00       14.78     .25         30.03   GROUP TOTAL
BILL> Q(CR)

 GRD>
```

Figure 29. SAIR Command Example (Sheet 3 of 3)

3.11 STEL COMMAND

(Refer to Figure 30.)

The STEL command provides the system manager with a listing of TELCO charges for the current or previous billing periods. The system manager is given the choice of specifying the listing of TELCO charges for the entire system, customer group or for a unit, talk group or range of units. CONTROL-X suspends the output and returns control to the billing prompt BILL>. Entering a Q for billing period returns control to the billing prompt.

- System number – 0B05 is replaced with the actual number for the system.

- Billing period – Last = billing period for the previous month, This = current billing period up to the current day.

- GROUP, TYPE II ID RANGE, ID, TALK GP, FLT IND, OR ALL Gxxx, Ixxxxxx–Ixxxxxx, Ixxxxxx, Txxxxxx, xxx xxx, OR (CR) – Enter a group number for information about an entire group , a range of Type II unit IDs to inclusively list only a portion of the IDs, a specific unit ID, a talk group ID for a specific talk group, an individual ID f or a specific fleet, or, a (cr). A (cr) results in all applicable units and talk groups being listed.

- No. of local calls – Actual number of local interconnect calls made during the billing period.

- Call charges – TELCO charges for local calls that were calculated by the CIT based upon length of call and exchange dialed.

- Taxes – Taxes for call charges as calculated by the CIT.

NOTE

The TELCO charges for the previous billing period are saved for an entire billing period. For example, the charges calculated for the period of 5–1 to 6–1 are saved until the date of 7–1.

NOTE

With Option D610, TELCO charges for *CoveragePLUS* roaming units are note listed.

```
 GRD> BILL(CR)

BILL> STEL(CR)
BILLING PERIOD (THIS/LAST) ? T(CR)
GROUP, TYPE II ID RANGE, ID, TALK GP, FLT IND, OR ALL
Gxxx, Ixxxxxx-Ixxxxxx, Ixxxxxx, Txxxxxx, xxx xxx, OR (CR): (CR)
LOCAL CALL CHARGE FROM  1- 1 THRU  1-15 FOR SYSTEM 0B05
------------------------------------------------------------------------------
CUSTOMER UNIT     LOCAL      CALL          TAXES        TOTAL
  GROUP   ID      CALLS     CHARGES    ST-LOC   FED     CHARGE
------------------------------------------------------------------------------
   001    001        0        .07       .00      .00            .07
   001    002        0        .07       .00      .00            .07
   001    027        0        .07       .00      .00            .07
   001    028        0        .07       .00      .00            .07
   001    02C        0        .07       .00      .00            .07
   001    02D        0        .07       .00      .00            .07
   001    02E        0        .07       .00      .00            .07
   001    02F        0        .07       .00      .00            .07
   001    030        0        .07       .00      .00            .07
   001    031        0        .07       .00      .00            .07
   001    032        0        .07       .00      .00            .07
   001    033        0        .07       .00      .00            .07
   001    034        0        .07       .00      .00            .07
------------------------------------------------------------------------------
          13         0        .91       .00      .00            .91   GROUP TOTAL

   012  I757345      0        .00       .00      .00            .00
------------------------------------------------------------------------------
           1         0        .00       .00      .00            .00   GROUP TOTAL

   022  I757346      0        .00       .00      .00            .00
   022  I757347      0        .00       .00      .00            .00
------------------------------------------------------------------------------
           2         0        .00       .00      .00            .00   GROUP TOTAL

------------------------------------------------------------------------------
          16         0        .91       .00      .00            .91   GROUP TOTAL

BILL> Q(CR)

 GRD>
```

Figure 30. STEL Command Example

3.12 CLNG AND SLNG COMMANDS

The CLNG and SLNG commands provide a means to extract billing information from the system. There are two distinct types of format. The first (SLNG) is a type that is meant for human use, in other words, human readable. The second (CLNG) is meant for input to a computer system and the data is sent in a compressed format that is very difficult for a human to read, but easier for a computer to use.

3.12.1 SLNG Command (Refer to Figure 31.)

The SLNG command gives the system manager a report detailing long distance and toll calls made on the system, or, if logging is turned on, all calls made. The programs that produce these reports have limited memory space in which to store call records. On those systems with many interconnect users, it may be necessary to run this report and clear memory more frequently than once per month. CONTROL–X suspends the output and returns control to the billing prompt.

3.12.2 CLNG Command (With Option D436 Only)

This form of the command provides output in a specific format for use by a computer that takes this data and post process it into other documents to be used for billing purposes. There

- A CRC check has been added to each individual call record so that it is easy for a receiving computer to determine if the record was received error free.
- Call records have been compressed so that transmission of the data can be accomplished in a much shorter time.
- An ENQ character is sent at the end of each record rather than a (cr). The upload computer should calculate the CRC for the received record and, if it agrees with the transmitted value, the computer should send an ACK character to the central controller, and the central controller will then send the next record. If the CRC calculation does not agree with the value received, the computer should send a NAK character and the central controller will resend the last record.
- A End of Transmission record is sent indicating the total number of records that were sent.

Following are details for 3 distinct types of records. The first is a header record that gives the system ID and date being reported. The second is the data records (one for each billing record). The third is a closing record which indicates the end of the data and also tells how many records were transmitted in the batch.

— HEADER RECORD — 22 bytes

Bytes	ASCII	HEX#	Dec#	Description
1–2	SYN	16	22	Synchronization characters.
3	SOH	1	1	Start of header character.
4	H	48	72	ASCII ‘H’ for header record.
5	STX	2	2	Start of text character.
6–9	–	–	–	Start date in ASCII (MMDD)
10–13	–	–	–	Ending date in ASCII (MMDD)
14–17	–	–	–	System ID in ASCII (e.g. 0509)
18	ITB	1F	31	Unit separator.
19–22	–	–	–	CRC checksum for bytes 4–18, inclusive

— DATA RECORDS — 40 bytes

Bytes	ASCII	HEX#	Dec#	Description
1–2	SYN	16	22	Synchronization characters.
3	SOH	1	1	Start of header character.
4	D	44	68	ASCII ‘D’ for data record.
5	STX	2	2	Start of text character.
6–8	–	–	–	Customer group number.
9	–	–	–	Record type indicator.
10–13	–	–	–	Unit ID number.
14–17	–	–	–	Month and day of call (MMDD)
18–21	–	–	–	Time of call (HHMM - 24 hour clock)
22–23	–	–	–	Length of call in minutes.
24–35	–	–	–	Number dialed, right justified.
36	ITB	1F	31	Unit separator.
37–40	–	–	–	CRC checksum for bytes 4–36, inclusive

— ENDING RECORD — 14 bytes

Bytes	ASCII	HEX#	Dec#	Description
1–2	SYN	16	22	Synchronization characters.
3	SOH	1	1	Start of header character.
4	N	44	68	ASCII ‘N’ for ending record.
5	STX	2	2	Start of text character.
6–9	–	–	–	Number of records transmitted.
10	ETX	3	3	End of text character..
37–40	–	–	–	CRC checksum for bytes 4–10, inclusive

CRC Calculations

Refer to the CRC routine used, described by Yoseph Linde in ‘Fast Algorithms for Calculating Cyclic Redundancy Checks’, Motorola Correlations, VOL 2, Number 1, Fall 1979.

Clearing Records

After all of the data has been sent to the receiving unit, CLNG/SLNG asks if records are to be cleared. It is assumed that the receiving computer calculates the CRC for each record and also checks the number of records received as shown in the ending record. If any of this information is in error, an N(CR) should be entered and the data downloaded again. If everything appears to be in order, a Y(CR) can be entered and the records can be purged from the CIT.

Sample Session

(Refer to Figure 32.)

NOTE

The Figure 32 output is broken into lines in the example for clarity only. As the data is received at the recording device, no carriage returns or line feeds are seen.

```
 GRD> BILL(CR)

BILL> SLNG(CR)

LONG DISTANCE CALLS FROM  5- 2 THRU  5-30 FOR SYSTEM 153B
-----------------------------------------------------------------------------
  GROUP  UNIT    DATE    TIME   MINUTES      NUMBER
-----------------------------------------------------------------------------
   000    S01    5-24    747A       1    LAND     902048

   001    123    5-05    817A       2       815-555-2478
   001    123    5-10   1105P       5       815-555-4701
   001    123    5-12    148P       3       815-555-5419

   001 I757345   5-07    734A       3       309-555-5063

   003 I757346   5-12   1050P       2       608-555-4728
   003 I757346   5-29   1026A       4       509-555-3168

   700 I757347   5-15   1116A       1    LAND     757347
-----------------------------------------------------------------------------
CLEAR LONG DISTANCE RECORDS (Y/N) ? N(CR)

BILL> Q(CR)

 GRD>
```

Figure 31. SLNG Command Example

```
 GRD> BILL(CR)

BILL> CLNG(CR)


H09270927151ALAFA
D000F00150927110801L     229397NFII
D000F00150927111001L      229397K@LO
D000F0015092711101     5762477KAOB
D000S00010927111201L     902048KJIF
D700 E0030927111601L     75734 7N@MK
D700 E003092711701     5762477DMEC
D700T0E010927111801L     803585MOEC
N0007KFML
CLEAR LONG DISTANCE RECORDS (Y/N) ? Y(CR)

BILL> Q(CR)

 GRD>
```

Figure 32. CLNG Command Example

```
 GRD> BILL(CR)
BILL> LOGY(CR)
BILL> LOGN(CR)
BILL> LOGY(CR)          ☜ Option D228
ATA LOGS ALL CALLS
```

Figure 33. LOGY and LOGN Command Examples

```
 GRD> BILL(CR)
BILL> PBXY(CR)
BILL> PBXN(CR)
```

Figure 34. PBXY and PBXN Command Examples

3.13 LOGY AND LOGN COMMANDS
(Call Logging Function) (Refer to Figure 33.)

The system manager can choose to turn on CALL LOGGING, which results in a long distance call record being generated for every call, whether land–to–mobile or mobile–to–land. This logging would be in addition to the normal airtime and TELCO billing records that take place. The call can be listed and cleared from memory with the SLNG or CLNG commands.

There is room in memory for 1450 call records (1300 on systems with TRAN) such as logging records, long distance call records, or 0+ credit card call records. If the record space becomes full, true long distance and 0+ calls will be denied. An error message will be sent to the system manager, who must perform the CLNG or SLNG command and clear the memory.

Figure 33 provides examples of turning CALL LOGGING on (LOGY) and off (LOGN).

3.13.1 With Option D610

Calls to or from CoveragePLUS roaming units are not logged.

3.13.2 With Option D228

The LOGY and LOGN commands have no effect, as all calls are logged on the Air Time Accumulator.

3.14 PBXY AND PBXN COMMANDS
(PBX Processing) (Refer to Figure 34.)

If the interconnect system is used on a private system, such as a single company or possibly a public safety system, the system manager may elect to turn on 'PBX PROCESSING'. This is normally used where the telephone system that the CIT connects to is a private PBX, where internal 4–digit numbers are normally dialed, or a public phone system where the dialing is standard, as in 7–digit local numbers and 10–digit toll numbers, but the TELCO billing is not required (such as in a public safety system).

When PBX processing is active (turned on by the system manager in the BILL command), authorization does not process the phone number dialed for mobile–to–land calls other than 0+ or 1+ calls. In other words, **the mobile unit is allowed to dial any phone number except those beginning with a 0 or a 1 unless 1+ or 0+ is enabled for that unit.** The number dialed can be monitored in either of two ways, however. One way is to turn on logging, which generates a call record for every call, mobile–to–land or land–to mobile. The second way is to use the MEXC command in BILL to set the exchange rate for exchange 200 to toll (15,15). Exchange 200 is used for each call when PBX processing is turned on. If logging is off, and the rate for exchange 200 is set to (15,15), only mobile–to–land calls generate call records, which can be read and cleared with the CLNG/SLNG command in BILL. Mobile–to–land calls are not shut off if the records become full. Memory provides room for 1450 (or 1300) call records.

If the exchange rate for exchange 200 is set to free (00,00), and logging is turned on, each call (mobile–to–land or land–to–mobile) is logged into the call records and the 'Local Call' count in the BILL STEL summary is increased by 1 for each mobile–to–land call.

If the exchange rate for exchange 200 is set to metered charge rate, such as (01,00), each mobile–to–land call is billed 1 unit. If logging is on, then a call record is also generated.

When PBX processing is used, the audio from the subscriber unit is immediately 'cut–through' to the phone company allowing the mobile to pass DTMF digits directly on to the PBX. This allows the user to hear the 2nd dial tone and to know when to continue dialing, or hear a 'busy' if all circuits are busy. If the lines are marked as being PULSE lines, the system converts the DTMF tones from the subscriber unit into pulse tones for the pulse only phone line. If the '#' is dialed, then the system stops converting DTMF into pulse codes and passes the DTMF on to the phone lines. This accommodates those situations where some answering device (paging terminal or other device) can use only DTMF codes, even though only pulse codes could be used to get to the device. For example, if the line is coded PULSE only , if the number 9 555 1212 # 4321 is dialed from the subscriber unit, the 9 555 1212 would be converted to pulse, but the 4321 would be passed in DTMF mode.

Figure 34 provides examples of turning PBX processing on (PBXY) and off (PBXN).

3.15 RSET COMMAND

The RSET command allows the operator to execute the INIT command a second time thereby eliminating all previously entered airtime and TELCO charge parameter information. This command should only be used to clear a condition in which the majority of airtime and TELCO charge parameter information is invalid. The parameters are cleared upon execution of the INIT command after the RSET command. Refer to Figure 35.

The RSET command can also be used after an AUTHORIZATION RESET command to possibly save the airtime and TELCO charge parameters including the local area code exchange rate entries. Refer to Figure 36.

NOTE

A more efficient method of database backing is provided with MSAVE/MLOAD. Refer to paragraphs 2.10 and 2.11.

The RSET command must also be used following the AUTHORIZATION MLOAD command in order to reactivate billing charge parameters. Refer to Figure 37.

```
 GRD> BILL(CR)

BILL> RSET(CR)
USE 'INIT' INPUT TO CALCULATE BILLING CHARGES (Y/N)? N(CR)
BILL> INIT(CR)
....
....
....
```

Figure 35. RSET Command, Invalid Parameter Example

```
 GRD> AUTH(CR)

AUTH> RESET(CR)
CLEAR ALL AUTHORIZATION & BILLING DATA, ARE YOU SURE (Y/N)? Y(CR)
AUTHORIZATION & BILLING RESET
AUTH>
INACTIVE USER LIST
 GRD> BILL(CR)
BILL> RSET(CR)
USE 'INIT' INPUT TO CALCULATE BILLING CHARGE (Y/N)? Y(CR)
BILL>
```

Figure 36. RSET Command, Saving Parameters Example

```
AUTH> MLOAD(CR)

AUTH>
AUTHORIZATION INACTIVE
ACTIVATE AUTHORIZATION LIST (Y/N)? Y(CR)
AUTH> Q(CR)
 GRD> BILL(CR)
BILL> RSET(CR)
USE 'INIT' INPUT TO CALCULATE BILLING CHARGES (Y/N)? Y(CR)
BILL>
```

Figure 37. RSET following AUTH> MLOAD *Action*

```
BILL> Q(CR)
 GRD>
```

Figure 38. Billing QUIT Command Example

```
GGRD> IL(CR)
GGRD>
```

Figure 39. ENABLE MEMORY PAGE Command Example

```
GGRD> TS(CR)
GGRD> RW(CR)
GGRD> IL(CR)
GGRD> L(CR)
GGRD> IH(CR)
GGRD> L(CR)
GGRD> Q(CR)
```

Figure 40. LOAD TAPE–TO MEMORY Command Sequence Example

3.16 QUIT COMMAND
(Refer to Figure 38.)

The QUIT command exits from BILL. Control is returned to the GRD > prompt.

3.17 GRDD COMMAND

The GRDD routine adds the ability to save and load certain parts of system memory to avoid having to re–type–in by hand certain tables and parameters in the event system memory is lost or becomes corrupted. The system uses Motorola S records to save memory on tape or restore memory from tape. Refer to Figure 41 for connection details.

NOTE

> The AUTH > MSAVE/MLOAD procedures provide a more efficient method of backing up the database. Refer to paragraphs 2.10 and 2.11.

The GRDD command causes the system manager to enter the GUARDIAN processor. This processor is used to download MCB memory to a tape or upload data from a tape to MCB memory. Once you have entered the processor, all interconnect calls will be disabled, any calls in process will be terminated. The prompt 'GRDD >' will appear. To this prompt, a variety of commands can be given. A summary of those commands is shown in Table 1.

3.17.1 ENABLE MEMORY PAGE Command
(Refer to Figure 39.)

This command selects the page of memory that is to be saved to tape or restored from tape. The character that follows the command should be 'L' (low) for page 0 or 'H' (high) for page 1.

Table 1. GRDD Command Summary

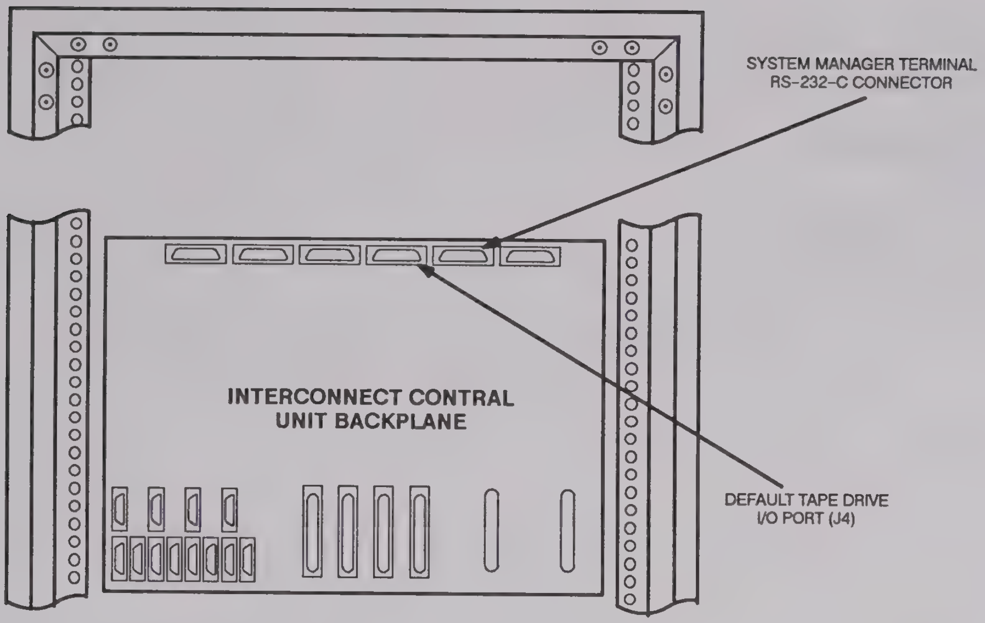
Command	Paragraph	Description
IL or IH	3.16.1	Enable page 0 (L for low) or page 1 (H for high) of dynamic RAM.
L	3.16.2	Load tape contents into dynamic RAM.
P x–y	3.16.3	'Punch' memory contents specified onto tape. Save from address x to y inclusive.
Q	3.16.4	Leave GUARDIAN and return to BILL > prompt.
RW	3.16.5	Rewind the tape in the tape recorder.
TD	3.16.6	Set tape I/O to AUX PORT J4.
TS	3.16.7	Set tape I/O to SMT port.
V	3.16.8	Verify tape contents.
CONTROL-X	3.16.9	Terminate upload/download to/from tape.

3.17.2 LOAD TAPE–TO–MEMORY Command
(Refer to Figure 40.)

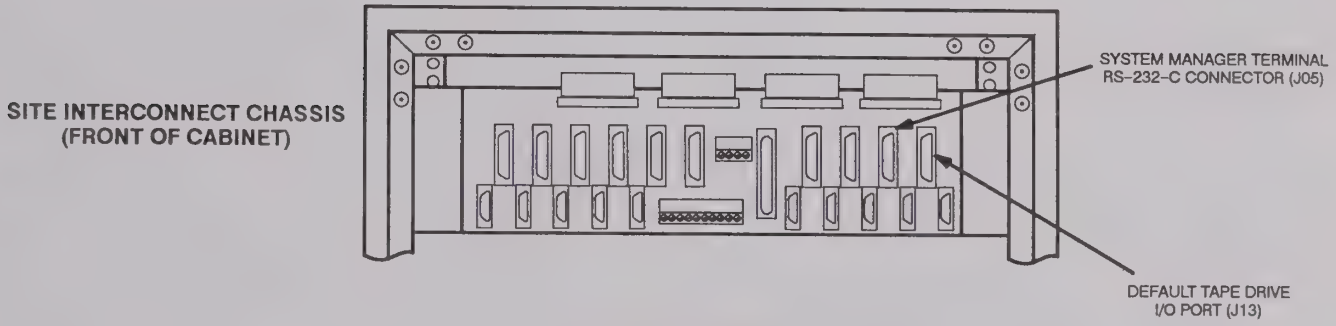
This command moves data saved on tape back into the MCB. Before issuing the LOAD command, there are several items to consider.

1. If the tape unit is 'in series' with the system manager terminal, enter the TS command so the proper data path is established. The normal mode is TD. Refer to Figure 41 to determine which type connection you have.

2. Enter the 'RW' command to rewind the tape to the beginning. Wait for the rewind lamp to go out. (If the unit is located remotely, wait one full minute.)


SYSTEM MANAGER TERMINAL
RS-232-C CONNECTOR
INTERCONNECT CONTRAL
UNIT BACKPLANE
DEFAULT TAPE DRIVE
I/O PORT (J4)

A. *Privacy Plus Enhanced/ShareNet*, *SMARTNET II*, & *SMARTNET II+* MODELS


SITE INTERCONNECT CHASSIS
(FRONT OF CABINET)
SYSTEM MANAGER TERMINAL
RS-232-C CONNECTOR (J05)
DEFAULT TAPE DRIVE
I/O PORT (J13)
IAEPS-47913-O

B. *SmartWorks* MODELS

Figure 41. Connector Locations for GRDD Tape Backup

```
GGRD> TS(CR)
GGRD> RW(CR)
GGRD> IL(CR)
GGRD> P 0-7FFF(CR)
GGRD> IH(CR)
GGRD> P 0-7FFF(CR)
GGRD> P 9000-9FFF(CR)
GGRD> Q(CR)
```

Figure 42. PUNCH MEMORY–TO–TAPE Command Sequence Example

```
GGRD> Q(CR)

PLEASE LOGIN
```

Figure 43. QUIT Command Example

```
GGRD> RW(CR)
GGRD>
```

Figure 44. REWIND TAPE Command Example

3. Enter the ‘I’ command to select the proper page of dynamic RAM. This is normally the ‘IL ’ command for the first page of memory and ‘IH’ for the second page of memory.
4. Enter the ‘L’ command to load page 0 of RAM.
5. Repeat steps 3 and 4 for each additional page of memory that is to be restored.
6. Enter the ‘L’ command to load static RAM.
7. Enter the ‘Q’ command to exit from GRDD > and restore call processing functions (all interconnect call processing is suspended during the time you are in GRDD).
8. Check the time and date and reset them if necessary.

At a rate of 9600 baud, it takes about 3 minutes to load each page of RAM. At slower speeds, longer times are required (for example, it takes 96 minutes at 300 baud).

3.17.3 PUNCH MEMORY–TO–TAPE Command
(Refer to Figure 42.)

This command moves data from the MCB into the tape unit. Before issuing the PUNCH command, there are several items to consider.

1. If the tape unit is ‘in series’ with the terminal, enter the TS command so the proper data path is established. The normal mode is TD. Refer to instruction section 68P81081E86 provided following the SYSTEM OVERVIEW divider tab of this manual to determine which type connection you have.
2. Enter the ‘RW’ command to rewind the tape to the beginning. Wait for the rewind lamp to go out. (If the unit is located remotely, wait one full minute.)
3. Enter the ‘I’ command to select the proper page of dynamic RAM. This is normally the ‘IL’ command for the first page of memory and ‘IH’ for the second page of memory.
4. Enter the ‘P 0–7FFF’ command to record page 0 of RAM.
5. Repeat steps 3 and 4 for each additional page of memory that is to be recorded.
6. Enter the ‘P 9000–9FFF’ command to record static RAM.
7. Enter the ‘Q’ command to exit from GRDD > and restore call processing functions (all call processing is suspended during the time you are in GRDD). You can also verify that the tape record is good. If this is desired, follow the commands listed under the VERIFY command.

At a rate of 9600 baud, it takes about 3 minutes to record each page of RAM. At slower speeds, longer times are required (for example, it takes 96 minutes at 300 baud).

3.17.4 QUIT Command
(Refer to Figure 43.)

The QUIT command exits from GRDD by resetting the MCB. When this command is given, the interconnect resets and follows standard powerup procedures.

3.17.5 REWIND TAPE Command
(Refer to Figure 44.)

This command causes GRDD to send a CONTROL–Z character to the tape recorder. With most recorders, this command causes the unit to rewind the tape to the beginning.

```
GGRD> TS(CR)
GGRD>
```

Figure 45. SET TAPE I/O to SYSTEM MANAGER PORT Command Example

```
GGRD> IL``TD(
GGRD>
```

Figure 46. SET TAPE I/O DEFAULT Command Example

```
GGRD> TS(CR)
GGRD> RW(CR)
GGRD> IL(CR)
GGRD> V(CR)
GGRD> IH(CR)
GGRD> V(CR)
GGRD> V(CR)
GGRD> Q(CR)
```

Figure 47. VERIFY Command Example

```
GGRD> CONTROL-X(CR)
GGRD>
```

Figure 48. CONTROL–X Command Example

3.17.6 SET TAPE I/O to SYSTEM MANAGER PORT Command

(Refer to Figure 45.)

When GRDD is first entered, tape I/O goes through AUX PORT J4. If the recorder is connected to the system manager port, this command must be issued to cause the I/O to go through the system manager port. Refer Figure 41 to determine which type connection you have.

3.17.7 SET TAPE I/O DEFAULT Command

(Refer to Figure 46.)

This command sets the tape recorder I/O through AUX PORT J4. This is the normal mode. This command is needed only if the mode was changed with the 'TS' command earlier in the session.

3.17.8 VERIFY Command

(Refer to Figure 47.)

This command verifies that recorded data from the MCB is good. Before issuing the VERIFY command, there are several items to consider.

1. If the tape unit is 'in series' with the terminal, enter the TS command so the proper data path is established. The normal mode is TD. Refer to Figure 41 to determine which type connection you have.
2. Enter the 'RW' command to rewind the tape to the beginning. Wait for the rewind lamp to go out. (If the unit is located remotely, wait one full minute.)
3. Enter the 'I' command to select the proper page of dynamic RAM. This is normally the 'IL' command for the first page of memory and 'IH' for the second page of memory.
4. Enter the 'V' command to verify page 0 of RAM.
5. Repeat steps 3 and 4 for each additional page of memory that is to be verified.
6. Enter the 'V' command to verify static RAM.
7. Enter the 'Q' command to exit from GRDD > and restore call processing functions (all call processing is suspended during the time you are in GRDD).

At a rate of 9600 baud, it takes about 3 minutes to verify each page of RAM. At slower speeds, longer times are required (for example, it takes 96 minutes at 300 baud).

3.17.9 CONTROL–X Command

(Refer to Figure 48.)

The CONTROL–X command aborts the current process (LOAD, PUNCH or VERIFY). This is done by holding the CONTROL key down and typing an 'X' on the keyboard. Note that no (CR) is required after the CONTROL–X.

4. TELL COMMANDS

(Refer to Figure 49.)

The TELL command family permits the system manager to enable, disable or check the current status of a particular telephone repeater interface (TRIB) or a particular phone line interface (PLIB). Other TELL commands allow the specification of pulse or DTMF dialing for each phone line interface, assign the phone company answer threshold time and allow the specification of the physical connection of a particular telephone repeater interface to a particular central channel number. A summary of the TELL command follows.

Command	Description
Enable	Enable a particular TRIB or PLIB circuit.
Disable	Disable a particular TRIB or PLIB circuit.
Status	Status of a particular TRIB or PLIB circuit.
Phone	Phone line dialing specification (DTMF or pulse) and answer threshold time (0–60 seconds).
Repeater	TRIB to central controller connection specification.
Quit	Exit to GUARDIAN prompt GRD >.

An explanation of the Figure 49 example follows.

- Central RF channel # – refers to repeater number.
- Repeater interface # – refers to TRIB number.
- Enable, disable, status – The enable, disable and status of a phone interface circuit or a repeater interface circuit is accomplished as shown. A space is required between the command (E,D or S), the interface designator (P or R) and the interface circuit number. The phone interface status of 'in sync' or 'out of sync' refers to the serial data communication link between the PLIB and the master control processor board.

NOTE

When an enable or disable is attempted, the terminal waits to return to the prompt until the command is executed and the result printed. If the operator does not want to wait for the result of the command to be printed, CONTROL–X can be entered to return to the prompt.

- Dialing specification – Outbound dialing to the TELCO office can be specified for each line as either DTMF or pulse compatible. The default mode is pulse dialing. Listing and editing of this data is shown for the P command.
- Answer threshold – The Answer threshold is a period of time, from 0 to 60 seconds, that the TELCO duration of the call must be beyond before the call is TELCO billed by the CIT software. For example, if the threshold is set to 25 seconds and the time from the last digit o f the phone number being entered and the end of the call is 15 seconds, then the call is assumed to be busy or unanswered and no TELCO charges are added to the user's record. If the time was 50 seconds instead of 15, TELCO charges for the 50 seconds are assessed to the subscriber unit account (minimum billing period amount is at least 1 minute). The system manager is free to set this threshold to a number that makes sense depending on how fast the TELCO lines work. Normally, 30 seconds is used. Properly using a non–zero threshold avoids overcharging for busy or unanswered calls.
- Repeater interface connection – The CIT sets the default connection between a telephone repeater interface circuit and a central rf channel to correspond to the TRIB placement in the CIT . For example, the default connection specification for the three telephone repeater interfaces located on a TRIB in slot 1 is central RF channels 1, 2 and 3. For a TRIB located in slot 2, the connection specification is central RF channels 4, 5 and 6, etc. The process of editing the connection specifications is as shown in the listing of the R command. The letter 'X' should be entered for REPEATER INTERFACE # when there is no TRIB on that channel.

```
 GRD> TELL(CR)
TELL> E R 1(CR)
REPEATER INTERFACE #01 ENABLED
TELL> D R 1(CR)
REPEATER INTERFACE #01 DISABLED
TELL> E P 1(CR)
PHONE INTERFACE #01 ENABLED
TELL> D P 1(CR)
PHONE INTERFACE #01 DISABLED
TELL> S R 2(CR)
STATUS OF REPEATER INTERFACE #02
ENABLED
NOT ASSIGNED
NOT MALFUNCTIONED
MUTED
TELL>
```

Figure 49. TELL Command Example (Sheet 1 of 2)

```
TELL> S R ALL(CR)

CHANNEL-#  INTERFACE  ENABLED  MALFUNCTIONED  ASSIGNED  MUTED
-------------------------------------------------------------
    01         01        NO          NO          NO       YES
    02         02        NO          NO          NO       YES
    03         03        NO          NO          NO       YES
    04         04        YES         NO          NO       YES
....
....
....
    27         18        NO          NO          NO       YES <--Up to 24 interfaces for
    28         19        NO          NO          NO       YES  SMARTNET II+ & Privacy
                                                               Plus-Enhanced with AMSS
TELL> S P 2(CR)
STATUS OF PHONE INTERFACE #02
IN SYNC
ENABLED
NOT MALFUNCTIONED
NOT ASSIGNED

TELL> S P ALL(CR)

INTERFACE  IN-SYNC  ENABLED  MALFUNCTIONED  ASSIGNED  TYPE  THRESHOLD
---------------------------------------------------------------------
    01       YES      YES        NO            NO     PULSE     00
    02       YES      NO         NO            NO     PULSE     00
    03       YES      NO         NO            NO     PULSE     00
....
....
....
    29       NO       NO         YES           NO     PULSE     00
    30       NO       NO         YES           NO     PULSE     00

TELL> P (CR)
PHONE#01 PULSE DIALING: D(CR)
ANSWER THRESHOLD 10: 15(CR)
PHONE#02 PULSE DIALING: D(CR)
ANSWER THRESHOLD 5: 15(CR)
PHONE#03 PULSE DIALING: (CR)
ANSWER THRESHOLD 15: Q(CR)
TELL> R (CR)
CENTRAL RF CHANNEL #01 REPEATER INTERFACE #01: X(CR)
CENTRAL RF CHANNEL #02 REPEATER INTERFACE #02: X(CR)
CENTRAL RF CHANNEL #03 REPEATER INTERFACE #03: 01(CR)
CENTRAL RF CHANNEL #04 REPEATER INTERFACE #04: 02(CR)
CENTRAL RF CHANNEL #05 REPEATER INTERFACE #05: 03(CR)
CENTRAL RF CHANNEL #06 REPEATER INTERFACE #06: Q(CR)
TELL> R (CR)
CENTRAL RF CHANNEL #01 REPEATER INTERFACE #X: (CR)
CENTRAL RF CHANNEL #02 REPEATER INTERFACE #X: (CR)
CENTRAL RF CHANNEL #03 REPEATER INTERFACE #01: (CR)
CENTRAL RF CHANNEL #04 REPEATER INTERFACE #02: (CR)
CENTRAL RF CHANNEL #05 REPEATER INTERFACE #03: (CR)
CENTRAL RF CHANNEL #06 REPEATER INTERFACE #06: Q(CR)
TELL> Q (CR)

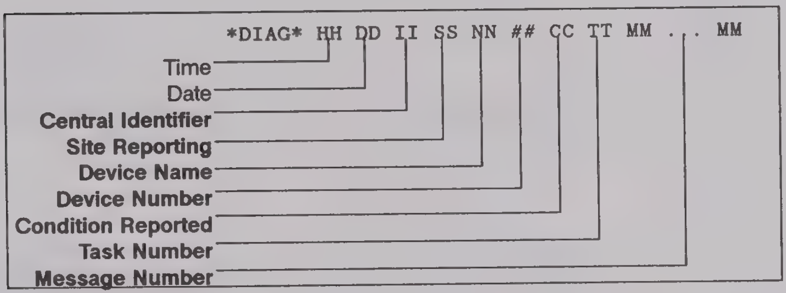
 GRD>
```

Figure 49. TELL Command Example (Sheet 2 of 2)

MOTOROLA INC.
Communications
Sector

AUTOMATIC SYSTEM ALARM CAPABILITY

SMARTNET II, *Privacy Plus–Enhanced*,
and *SmartWorks* Models



Central Identifier
Specifies reporting Central and its Active/Idle Status

MA : Main Central, Active
MI : Main Central, Idle
BA : Backup Central, Active
BI : Backup Central, Idle

Site Reporting
00 : Main Site
01–99 : Remote Sites

Device Name
Specifies device referred to in message by name; xx indicates channel or port no.

ADCB : AMSS Data Concentrator Board
BIM xx : Base Interface Module
CACB xx : CSC Async Comm Board
CRB : Clock Recovery Board
CSC : Central Site Controller
DACB xx : DCB Async Comm Board
DCB : Simulcast Data Concentrator Board
ICU – Interconnect Control Unit
IRB : Inbound Recovery Board
MCB : Master Control Board
PLIB xx : Phone Line Interface Board
ReSC : Remote Site Controller
RIB xx : Receiver Interface Board

Device Name (Cont'd)
RSC : Receiver Site Controller
RTIB xx : Remote Transmitter Interface Board
SIB – Site Interface Board
SAB – Site Audio Board
TACB xx : TCI Async Comm Board
TCI : Trunked Console Interface
TDC – Trunked Data Controller
TIB xx : Transmitter Interface Board
TIMI – Trunked I/O Multiplexed Interface
TRIB xx : Telephone Repeater Interface Board
TSC : Transmitter Site Controller

Device Number (Hex)
Specifies the subsystem or interface referred to in the message.

00–14 : Base Interface Module
15–1E : TACB Interface
20 : TIMI (Trunked I/O Multiplexed Interface)
21 : Trunked Console Interface
22 : TIMI – Active (Trunked Interface Module Interface)
23 : TCI-TSC Link
24 : TDC
40–54 : Receiver Interface
55 : Receiver Site Controller

Device Number (Hex) (Cont'd)
56 : Inbound Recovery Board
57 : Clock Recovery Board
58 : Remote Site Controller
59 : Site Audio Board
5A, 5B : AMSS Remote Site Controller
60–74 : Transmitter Interface
75 : Transmitter Site Controller
76–8A : Remote Transmitter Interface
90 : Data Concentrator Board
91–9A : DACB Interface
9B : TCI-DCB Link
9D : CSC AMSS DCB2 Link
9E : ReSC-DCB Link
9F : AMSS Data Concentrator Board
A0–B7 : Telephone Repeater Interface
B8 : Master Control Board/ Interconnect Control Unit
B9–D7 : Phone Line Interface
E0 : Central Site Controller
E1–EA : CACB Interface
EB : Redundant Link
EF: ReSC–ACB Link
F0–FE : Site Interface Board

Condition Reported (Hex)
Specifies the general type of action

04 : Link Failure
05 : Link Enable
0A : Enable Device
0B : Disable Device
0C : Malfunction Device
0D : Information Message
0E : Diagnose Device
0F : Error Message

Task Number (Hex)
Specifies the software task within the specified reporting device

Message Number (Hex)
Specifies the actual failure or action taken; definitions may vary for each reporting device. Most messages contain a single number but two or more may be issued.

Figure 1. Error Message Format

1. INTRODUCTION

The central controller is designed to alert the system manager when certain central controller or repeater malfunctions occur. This is done in two ways. One is the automatic generation of diagnostic messages on the system manager's terminal (with the system manager's terminal connected to the central controller and in the active mode). The other way is activation of an external alarm device by means of relay contacts triggered by failures reported to the central controller. No external alarm device is supplied with the central controller, however relay contacts are provided. For external alarm connection details, refer to paragraph 3.

The central controller generates error messages in the standard format shown in Figure 1.

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2. SYSTEM MANAGER TERMINAL ALARM MESSAGES

2.1 GENERAL

The system manager terminal automatically prints out alarm messages if, and only if, the following conditions are met:

for all models

- The central controller is active or idle.
- A central controller–detectable malfunction occurs in either the central controller or a base–repeater station.
- Diagnostic mode is automatic, i.e., 1) the AUTOMATIC command was issued to the DIAG subsystem, 2) the MANUAL command was never given after the system was first started, or 3) after a system memory loss.

for models with telephone interconnect

- The system manager terminal is connected to the central interconnect terminal and is in the active mode.
- The central interconnect terminal is active.

for models without telephone interconnect

- The system manager terminal is connected to the central controller and is in the active or idle mode.

2.2 MESSAGE EXAMPLES

Examples:

```
*DIAG* 00:00:00 01/01/86 MA 00 CSC E0 0F 08 21
```

Central/Status : Main/Active
Site : Prime
Device Name : CSC
Device Number : E0
Condition Reported : 0F - Error Message
Task Number : 08
Message Number : 21 - Entered failsoft due to no RSC link

```
*DIAG* 00:00:00 01/01/86 BI 00 RIB 11 4A 0C 00 25
```

Central/Status : Backup/Idle
Site : Prime
Device Name : RIB 11
Device Number : 4A
Condition Reported : 0C - Malfunction Device
Task Number : 00
Message Number : 25 - Disconnect tone failure

2.3 ERROR MESSAGES

2.3.1 BIM (Base Interface Module)

DEVICE NO (HEX): 00 – 14

TASK ID NUMBER: 00
TASK NAME:

00 – BIM status change; condition shows current status.

2.3.2 TACB (TCI Asynch Communications Board)

DEVICE NO (HEX): 15 – 1E

TASK ID NUMBER: 01
TASK NAME:

10 xx – TIMI link status change; condition shows current status. xx = number of links in service.
2F xx – TIMI front panel switch change; condition shows current status. xx = number of links in service.

2.3.3 TIMI (Trunk Interface Module Interface)

DEVICE NO (HEX): 20

TASK ID NUMBER: 00
TASK NAME:

00 – TIMI link status change; condition shows current status.

2.3.4 TCI (Trunked Console Interface)

DEVICE NO (HEX): 21

TASK ID NUMBER: 00
TASK NAME: Interface

01 – TCI Restart – lack of tickle or manual reset.
02 – TCI Restart – power fail.
03 – TCI Restart – DRAM checksum error.
04 – TCI Restart – diagnostic received test started.
05 – TCI Restart – no short bins.
06 – TCI Restart – no long bins.
07 – TCI Restart – lost link to CSC.

10 – Link enabled.
11 –
12 – This link has detected a DCD error.
13 – No CTS on this port.
14 – This link has detected a framing error.
15 – This link has detected a over–run error.
16 – This link has detected a parity error.
17 –
18 –
19 – ECHO sync was lost from device.
1A – Receive checksum error for this link.
1B – Receiver buffer overflow for this link.
1C – Unknown ACIA error for this link.
1D – Sent queue overflow for this link.

TASK ID NUMBER: 01
TASK NAME: SRVDEV

08 – Invalid opcode for an EDM command.
09 – Invalid device number for an EDM command.
0A – EDM command received from CSC with nothing pending.

TASK ID NUMBER: 02
TASK NAME: SRVMSC

08 – Invalid opcode for an EDM command.
09 – Invalid device number for an EDM command.
0B – Invalid PARM received from CSC.

2.3.4 TCI (Trunked Console Interface) (Cont)

DEVICE NO (HEX): 21

TASK ID NUMBER: 03
TASK NAME: ISWPRC

0D – 1st word ISW received but no 2nd word..
0E – 2nd word ISW received but no 1st word.
0F – Bad ID in regroup request.

TASK ID NUMBER: 04
TASK NAME: OSWPRC

---

11 – Bad OSW opcode.

TASK ID NUMBER: 05
TASK NAME: CHLPRC

0C – Channel processor received an invalid opcode..

2.3.5 TCI/TSC (Trunked Console Interface/ Transmitter Site Controller)

DEVICE NO (HEX): 23

TASK ID NUMBER: 00
TASK NAME:

---

00 – TCI/TSC status change; condition shows current status.

2.3.6 TDC (Trunked Data Controller)

DEVICE NO (HEX): 24

TASK ID NUMBER: 00
TASK NAME: Generic

---

08 – TCI–TDC link enabled and entering Data Fully-Operational Mode.
09 – TCI–TDC link disabled and entering Data Reduced-Operation Mode.

2.3.7 RIB (Receiver Interface Board)

DEVICE NO (HEX): 40 –54

TASK ID NUMBER: 00/01
TASK NAME: Generic/EDM

---

20 – Device status; condition shows current status..
23 – High speed tone test failure
24 – Low speed tone test failure
25 – Disconnect tone failure
26 – Illegal carrier malfunction
2D – RIB(/RTIB) status change due to a site removed from service.
2F – Front panel switch change; condition shows current status.

2.3.8 RSC (Receiver Site Controller)

DEVICE NO (HEX): 55

TASK ID NUMBER: 00
TASK NAME: Generic

---

01 – RSC restart – lack of tickle.
02 – RSC restart – power fail.
03 – RSC restart – lost battery–backed RAM.
04 – RSC restart – test started.
05 – RSC restart – ACIA error.
06 – RSC restart – BIN error.
07 – CSC assigned an already assigned channel (INQWRK).
08 – CSC sent an unknown PARM (INQWRK).
09 – Unknown opcode error (INQWRK).
0A –
0B –
0C – Device number out of range (INQWRK).
0D –
0E –
0F –
10 – RSC–CSC link enabled.
11 –
12 – This link has detected a DCD error.
13 – No CTS on the this port.
14 – This link has detected a framing error.
15 – This link has detected a overrun error.
16 – This link has detected a parity error.
17 –
18 –
19 – ECHO sync was lost on the this link.
1A – Receive checksum error for this link.
1B – Receiver buffer overflow for this link.
1C – Unknown ACIA error for this link.
1D – Sent queue overflow for this link.
1E –
1F –

2.3.9 IRB (Inbound Recovery Board)

DEVICE NO (HEX): 56

TASK ID NUMBER: 00/01
TASK NAME: Generic

---

20 – Device status; condition shows current status.
21 – IRB interrupt failure.
22 – IRB double buffer failure.
2D – IRB(/CRB) status change due to a site removed from service.

2.3.10 CRB (Clock Recovery Board)

DEVICE NO (HEX): 57

TASK ID NUMBER: 01
TASK NAME: EDM

---

20 – Device status; condition shows current status.
2B – Malfunction due to test failure.
2D – IRB(/CRB) status change due to a site removed from service.

2.3.11 ReSC (Remote Site Controller)

DEVICE NO (HEX): 58

TASK ID NUMBER: 00
TASK NAME: RCMD

---

01 – ReSC restart – lack of tickle.
02 – ReSC restart – power fail.
03 – ReSC restart – lost battery–backed RAM.
04 – ReSC restart – diagnostic receive test started.
05 – ReSC restart – lost DCB link..
06 – ReSC restart – BIN error.

TASK ID NUMBER: 01
TASK NAME: RCMD

---

07 – Assigned a previously assigned channel.
08 – Illegal PARM received.
09 – Unknown command.
0A – Illegal device address: STATUS RESPONSE
0B – Illegal device address: ENABLE
0C – Illegal device address: DISABLE
0D – Illegal device address: STATUS REQUEST
0E – Illegal device address: CHANNEL COMMAND
0F – Illegal device address: MALFUNCTION
30 – Illegal device address: DIAGNOSTIC
31 – Illegal device address: DATA TRANSFER
32 – Received XMIT CMD for front–panel disabled RTIB.
33 – Illegal device address: DEASSIGNMENT
34 – Illegal device address: ASSIGNMENT
35 – Assigning a channel with RIB or RTIB not enabled.
36 – Deassigning a deassigned RIB.
37 – Illegal device address in key, dekey, mute or unmute.
38 – Received key or dekey for disabled RTIB.
3D – All Remotes removed from service.
40 – No message.
41 – ReSC composite status change due to a site removed from service.
42 – ReSC Malfunction: Majority of channels out of service.
43 – ReSC Malfunction: All control channels out of service.
44 – ReSC Malfunction: CRB has lost lock on the control channel.
45 – ReSC Malfunction: DCB to ReSC link has malfunctioned.
47 – ReSC status change due to Idle/Active hardware change.
4F – ReSC disabled at ReSC front panel.

2.3.12 SAB (Site Audio Board)

DEVICE NO (HEX): 59

TASK ID NUMBER: 00
TASK NAME:

---

00 – SAB status change; condition shows current status.
01 – Reset flag (RSTFLG) initialization
02 – Power loss indicated.
03 – Invalid SAB device.
04 – Diagnostic restart.
05 – Reset due to ACIA error.
06 – BIN error.
07 – Invalid SIB device number.
09 – Unknown command received.
12 – DCD Interrupt detect.
14 – ACIA Framing error.
15 – ACIA Overrun error.
16 – ACIA Parity error.
1A – Checksum error on ACIA.
1C – Unknown ACIA error.

2.3.13 TIB (Transmitter Interface Board)

DEVICE NO (HEX): 60–74

TASK ID NUMBER: 00
TASK NAME: Generic

---

20 – Device status; condition shows current status.
21 – No TSTAT indication during test.
22 – TSTAT indication when not keyed (red light failure).
23 – No TSTAT during a call.
24 –
25 – Control channel failed test due to lack of TSTAT.
26 –
27 –
28 –
29 –
2A –
2B –
2C –
2D –
2E –
2F – Front panel switch change; condition shows current status.

2.3.14 TSC (Transmitter Site Controller)

DEVICE NO (HEX): 75

TASK ID NUMBER: 00
TASK NAME: Generic

---

01 – TSC restart – lack of tickle.
02 – TSC restart – power fail.
03 – TSC restart – lost battery–backed RAM.
04 – TSC restart – test started.
05 – TSC restart – ACIA error.
06 – TSC restart – BIN error.
07 – Repeat OSW for dekeyed channel.
08 – High speed data buffer overrun.
09 – Unknown Opcode.
0A – Buffer load not complete.
0B – OSW data buffer overrun.
0C – Channel number out of range.
0D – Channel command for disabled or malfunction channel.
0E – Illegal command for a control channel.
0F – Channel `IN OSW > 20`.
10 – TSC–CSC link enabled.
11 –
12 – This link has detected a DCD error.
13 – NO CTS on the this port.
14 – This link has detected a framing error.
15 – This link has detected an overrun error.
16 – This link has detected a parity error.
17 –
18 –
19 – ECHO sync was lost on this link.
1A – Receive checksum error for this link.
1B – Receiver buffer overflow for this link.
1C – Unknown ACIA error for this link.
1D – Sent queue overflow for this link.
1E –
1F –
30 – Did not get to priority work on this WFI.
31 – Count of FRF words in system fell below zero.

2.3.15 RTIB (Remote Transmitter Interface Board)

DEVICE NO (HEX): 76–8A

TASK ID NUMBER: 01
TASK NAME: EDM

---

20 – Device status; condition shows current status.
27 – Malfunction due to no TSTAT during test.
28 – Malfunction due to TSTAT present when not keyed.
29 – Malfunction due to no TSTAT during call.
2A – Malfunction due to no TSTAT for control channel.
2C – Malfunction due to CRB losing lock on control channel.
2D – RIB(/RTIB) status change due to site removed from service.
2F – Front panel switch change; condition shows current status.

2.3.16 DCB (Simulcast Data Concentrator Board)

DEVICE NO (HEX): 90

TASK ID NUMBER: 00
TASK NAME: Initialization

01 – DCB restart – lack of tickle or manual reset.
02 – DCB restart – power fail.
03 – DCB restart – lost battery-backed RAM.
04 – DCB restart – diagnostic received test started.
05 – DCB restart – lost CSC (TCI) link.
06 – DCB restart – BIN error.
07 – DCB Restart – invalid interrupt request.
10 – DCB link enabled.
11 –
12 – This link has detected a DCD error.
13 – NO CTS on this port.
14 – This link has detected a framing error.
15 – This link has detected an overrun error.
16 – This link has detected a parity error.
17 –
18 –
19 – ECHO sync was lost on the this link.
1A – Receive checksum error for this link.
1B – Receiver buffer overflow for this link.
1C – Unknown ACIA error for this link.
1D – Sent queue overflow for this link.
1E –
1F –

TASK ID NUMBER: 01
TASK NAME: EDMPRC

08 – Illegal data transfer (PARM).
09 – Unknown command from prim e site.
0A – Unknown command from remote site.
0B – Illegal source site for tone status update.
0C –
0D –
0E –
0F – Illegal lock command.
32 – Remote device status from CSC.
33 – Invalid site ID given for conversion.
36 – Illegal control channel update.
3D – ReSC status mismatch in status response.
3E – IRB status mismatch in status response.
3F – RIB status mismatch in status response.
40 – Remote update from master CSC while locked enabled.
41 – Remote update from master CSC while locked disabled.
42 – Remote update from master CSC while locked malfunctioned.
43 – Malfunction lost after confirmation.
44 – Address of site malfunction lost.
45 – Malfunction lost before confirmation.
46 – Remote MALFUNCTIONED due to CONTROL CHANNEL failure.
47 – Received invalid unrequested EDM command.
48 –
49 –
4A – Some status update with device locked enabled.
4B – Some status update with device locked disabled.
4C – Some status update with device locked malfunctioned.

TASK ID NUMBER: 02
TASK NAME: TBLACC

07 – Invalid site id to convert.
0C – Invalid device number to convert.
38 – Weight conversion to command error.
39 – Command conversion to weight error.

TASK ID NUMBER: 03
TASK NAME: TONPRC

0A –
0B – Illegal site for tone status update.
0C –
0D – Inappropriate device number for tone update.
34 – Tone update with ReSC not enabled.
35 – Tone update with RIB/TIB not enabled.
36 –
37 – Tone table conversion error.

TASK ID NUMBER: 04
TASK NAME: PMINTF

0E – Bad BIN from prime interface.
3A – DCB detected prime interface failure.

TASK ID NUMBER: 05
TASK NAME: RMINTF

30 – Remote link up.
31 – Remote link failure due to lack of received data.

TASK ID NUMBER: 07
TASK NAME:

48 – Invalid 3X command length requested.

2.3.17 DACB (DCB Asynchronous Communications Board)

DEVICE NO (HEX): 91–9A

TASK ID NUMBER: 06
TASK NAME:

2F – Front panel switch change; condition shows current status.

2.3.18 TCI/DCB Link

DEVICE NO (HEX): 9B

TASK ID NUMBER: 00
TASK NAME:

10 – Link status change; condition shows current status.
11 –
12 – This link has detected a DCD error.
13 – NO CTS on the this port.
14 – This link has detected a framing error.
15 – This link has detected an overrun error.
16 – This link has detected a parity error.
17 –
18 –
19 – ECHO sync was lost for this link.
1A – Receive checksum error for this link.
1B – Receiver buffer overflow for this link.
1C – Unknown ACIA error for this link.
1D – Sent queue overflow for this link.
1E –
1F –

2.3.19 CSC – AMSS DCB2 Link

DEVICE NO (HEX): **9D**

TASK ID NUMBER: **00**
TASK NAME:

10 – Link status change; condition shows current status.
11 –
12 – This link has detected a DCD error.
13 – NO CTS on the this port.
14 – This link has detected a framing error.
15 – This link has detected an overrun error.
16 – This link has detected a parity error.
17 –
18 –
19 – ECHO sync was lost for this link.
1A – Receive checksum error for this link.
1B – Receiver buffer overflow for this link.
1C – Unknown ACIA error for this link.
1D – Sent queue overflow for this link.
1E –
1F –

2.3.20 ReSC/DCB2 Link (from ReSC side)

DEVICE NO (HEX): **9E**

TASK ID NUMBER: **05**
TASK NAME: **RMINTF**

10 – Link enabled.
18 – Link failure due to lack of valid data.

2.3.21 ADCB (AMSS Data Concentrator Board)

DEVICE NO (HEX): **9F**

TASK ID NUMBER: **00**
TASK NAME: **INIT**

01 – DCB restart – lack of tickle or manual reset.
02 – DCB restart – power fail.
03 – DCB restart – lost battery–backed RAM.
04 – DCB restart – diagnostic received test started.
05 – DCB restart – lost CSC (TCI) link.
06 – DCB restart – BIN error.
07 – DCB Restart – invalid interrupt request.
10 – Link status change; condition shows current status.
11 –
12 – This link has detected a DCD error.
13 – NO CTS on this port.
14 – This link has detected a framing error.
15 – This link has detected an overrun error.
16 – This link has detected a parity error.
17 –
18 –
19 – ECHO sync was lost on the this link.
1A – Receive checksum error for this link.
1B – Receiver buffer overflow for this link.
1C – Unknown ACIA error for this link.
1D – Sent queue overflow for this link.
1E –
1F –

TASK ID NUMBER: **01**
TASK NAME: **EDMPRC**

08 – Invalid source for EDM command. xx = Opcode,
yy = Device, zz = Site/Reason code.
09 – Unknown EDM opcode received. xx = Invalid opcode.
0A – Invalid source for site status command.
0F – Invalid site status code received. xx = Invalid status code.
2E – Status change due to RCSC added/removed from wide area.
32 – Invalid site for status command. xx = Invalid site number.
36 – Invalid control channel update.
3B – Invalid source for PARM command.
3C – Invalid PARM number received.
xx = Invalid PARM number.
3D – Invalid source for BSI command.
3E – Invalid channel for BSI command.
xx = Invalid channel number.
3F – Invalid EDM device received. xx = Invalid device number.
40 – Invalid source for RIB/TIB command.
41 – Invalid source for RCSC command.
42 – Invalid source for DCB command.
43 – Invalid opcode for DCB command. xx = Invalid opcode.
44 – Invalid device for audio status command.
xx = Invalid device number.
45 – Invalid source for SAB command.
46 – Invalid opcode for SAB command. xx = Invalid opcode.
47 – Invalid opcode for unexpected RIB/TIB command.
xx = Invalid opcode.
49 – Invalid opcode for RCSC failsoft command.
xx = Invalid opcode.
4A – Invalid opcode for MCSC failsoft command.
xx = Invalid opcode.
4B – Invalid source for SIB command.
4C – Invalid opcode for SIB command.
4D – Invalid source for power up complete command.

TASK ID NUMBER: **02**
TASK NAME: **TBLACC**

33 – Invalid site id to convert.
38 – Weight conversion to command error.
39 – Command conversion to weight error.

TASK ID NUMBER: **03**
TASK NAME: **CHLPRC**

0B – Illegal source site for tone status update.
0D – Inappropriate device number for tone update.
xx = Invalid device number.
37 – Tone table conversion error.

TASK ID NUMBER: **04**
TASK NAME: **PMINTF**

0E – Bad bin from prime interface.
4D – ADCB detected RSC interface failure.
4E – ADCB detected TSC interface failure.

TASK ID NUMBER: **06**
TASK NAME: **ABACK**

3A – Invalid LED state requested.

2.3.21 ADCB (AMSS Data Concentrator Board) (Cont)

DEVICE NO (HEX): 9F

TASK ID NUMBER: 07
TASK NAME: GEN3X

48 – Invalid 3x command length requested.

TASK ID NUMBER: 08
TASK NAME: C3XPRC

50 – Invalid source for 3x command.
51 – Invalid type of 3x command received. xx = Invalid 3x type.
52 – Second of two 3x commands not received.
53 – Two first of two 3x commands received.
54 – Second of two 3x commands received without first.

TASK ID NUMBER: 09
TASK NAME: CLLPRC

0C – Re-assignment received for a channel not assigned.
xx = Channel number.
30 – Invalid call opcode received. xx = Invalid opcode.
34 – Invalid source number for call command.
35 – Invalid channel for call command; xx = Channel number.

2.3.22 TRIB (Telephone Repeater Interface Board)

DEVICE NO (HEX): A0–B7

TASK ID NUMBER: 00
TASK NAME:

2D – New assignment to a TRIB that is already assigned.
2E – Alert tone command from unassigned TRIB.
2F – Front panel switch change; condition shows current status.
31 – Aborting a call assigned to an unassigned TRIB.

2.3.23 MCB/ICU (Master Control Board/ Interconnect Unit)

DEVICE NO (HEX): B8
TASK ID NUMBER: 00
TASK NAME:

01 XZ MM LL – ICU restart – lack of tickle
02 XZ MM LL – ICU restart – power failure reset
03 XZ MM LL – ICU restart – battery–backed ram lost
04 XZ MM LL – ICU restart – test request reset
05 XZ MM LL – ICU restart – ACIA error
06 XZ MM LL – ICU restart – BIN error
07 XZ MM LL – ICU restart – error in dynamic RAM
X = F = Authorization Inactive
0 = Authorization Active
Z = F = Billing not initialized
0 = Billing Initialized
MM = 00 = Memory Test Passed
F1 = Static RAM checksum error
F2 = Dynamic RAM checksum error
LL = 00 = Long distance memory checksum correct
0A – Minor matrix malfunction.
0B – Cut-through relay malfunction.
0D – Matrix vertical failure.
10 – MCB–CSC link enabled.
12 – This link has detected a DCD error.
13 – NO CTS on the this port.
14 – This link has detected a framing error.

TASK ID NUMBER: 00 (CONT)
TASK NAME:

15 – This link has detected an overrun error.
16 – This link has detected a parity error.
19 – ECHO sync was lost for this link.
1A – Receive checksum error for this link.
1B – Receiver buffer overflow for this link.
1C – Unknown ACIA error for this link.
1D – Sent queue overflow for this link.
2B – Long distance call log 75% full, time to list and delete.
2C – Long distance call log full. Long distance calling disabled.
33 – Sixteen bytes of DRAM have been corrupted.
34 – A bin error in DRAM has occurred.
35 – Long distance call log error. Records cleared.
36 – Unknown MCB command from CSC.
37 – Invalid opcode in command from CSC.
38 – Invalid byte count in MCB task command.
39 – Unknown OSW command from CSC.
3A – Alert tone command for non–voice phase call.
3B – ICU decrement command abort.
3C – The CSC sent a call grant for an ID already on a call.
3D – RING OSW received for a call in the terminate phase.
3E – Could not find the call ID for RING OSW.
3F – RING OSW for a non–land–to–mobile call.
40 –
41 – L-to-M call skipped WAIT phase before RING phase.
42 – Additional diagnostic CMD from CSC, but test completed.

2.3.24 PLIB (Phone Line Interface Board)

DEVICE NO (HEX): B9–D7

TASK ID NUMBER: 00
TASK NAME:

07 – Dialtone detect failure.
08 – Audio synthesizer malfunction.
09 – DTMF decoder malfunction.
0C – Multiple PLIB malfunction.
21 – GLARE collision on land to mobile call.
22 – STOPPED RINGING status from off–hook and assigned PLIB.
23 – Two consecutive MCB reads from a PLIB did not match.
24 – Alert tone command received for call on a broken PLIB.
25 – Failure command for unassigned PLIB.
26 – Invalid PLIB command from CSC.
27 – Off–hook command on unassigned PLIB.
28 – Invalid request from PLIB.
29 – Onhook command from unassigned PLIB.
2A – Digits from unassigned PLIB.

2.3.25 CSC (Central Site Controller)/ReSC (Remote Site Controller)

DEVICE NO (HEX): E0

TASK ID NUMBER: 00
TASK NAME: Generic

01 – CSC restart – any kind
02 – CSC restart – power fail
03 – CSC restart – lost battery–backed RAM
04 – CSC restart – test started
05 – CSC restart – no long BIN
06 – CSC restart – no short BIN
07 – CSC restart – SMT reset
08 – RCSC restart – DCB/RCSC link failure
09 – Variable ID processor started with no work to do
10 – VIDPRC started with invalid command
11 – Dynamic talkgroup pool full
12 – Invalid DRAM page selected
13 – Invalid EPROM page selected

2.3.25 CSC (Central Site Controller)/ReSC (Remote Site Controller) (Cont)

DEVICE NO (HEX): E0

TASK ID NUMBER: 02
TASK NAME: NXTOSW

01 – Unknown command
02 – Repeat OSW stuck due to channel in improper state
03 – Repeat OSW stuck due to incorrect reverse threads

TASK ID NUMBER: 04
TASK NAME: INTFRX

11 – No bins on INTFTX work queue
12 – Unknown command to INTFTX

TASK ID NUMBER: 06
TASK NAME: ISWOSW

01 – Unknown task command (ISW DISPATCH processor)
02 XX XX CC – Unknown ISW request
  XX XX = ID
  CC = Call type
03 – OSW false reference and ISW (OSW expiration processor)
04 – Individual ID not defined by the hybrid partitioning table
05 – Received a type I request with invalid ID in a mixed fleet (ID < 16)
06 XX XX – ICU reject request for a call that ISW could not find. XX XX = 16 BIT ID
07 – Received a D0 or D3 out of sequence
08 – Call assigned to channel and RIB or TIB already assigned
09 – Call assigned to channel and D4 timer already active
0A – Call assigned to channel and D5 timer already active
0B – Call assigned to channel and D6 timer already active
0C – Interconnect call counter went out of range CURICU
0D – Interconnect call counter went out of range CURSP
0E – Reserve repeater count went too low
0F – Count of non–emergency calls went negative
10 XX XX YY YY CC – Received a dual word ISW for a service not yet available
  XX XX = 16 bit individual ID for first word
  YY YY = 16 bit talkgroup ID for second word
  CC = Call type
11 – DCB tried to assign call to control channel
12 – DCB tried to assign call to assigned channel
13 – Unit ID of selected group < > 0 in supergroup
14 – Number of reserved emergency channels went out of range
15 – 5 channel request issued to a 20 channel channel
16 – Checksum test on Normal/Tactical table failed
17 – ISW for changing Normal/Tactical state with no TCI
18 XX XX – Fleetwide emergency received.
  XX XX = 16 bit ID
19 XX – Systemwide call ID received
  XX = Call type
39 – Checksum test on Normal/Tactical flag table failed
40 – Illegal extended function ISW received (change in tactical state when no TCI9 is present)
41 – Received unknown ISW from the ADCB
43 XX XX – Individual ID out of range
  XX XX = 16–bit individual ID
44 XX XX YY YY – Talkgroup ID out of range
  XX XX = 16–bit individual ID
  YY YY = 16–bit talkgroup ID
46 XX XX YY YY ZZ ZZ – Improperly marked fleetwide talkgroup
  XX XX = 16–bit ID
  YY YY = talkgroup ID
  ZZ ZZ = fleet ID

TASK ID NUMBER: 06 (CONT)
TASK NAME: ISWOSW

47 – Invalid call type on passport busy queue
48 – SAC database lost and SAC function turned off
49 – Bad data in individual–to–talkgroup affiliation table
50 – Bad data in talk group–to–fleet affiliation database
51 – Count of regrouped members not consistent with number of regrouping bins queued up
52 – Bin found on channel table corresponding to 2nd set of patch PTT grants even though call is no longer active
53 XX XX YY YY ZZ ZZ – Fleet error for requesting fleetwide talkgroup
  XX XX = 16–bit ID
  YY YY = talkgroup ID
  ZZ ZZ = fleet ID
54 XX XX YY YY ZZ ZZ – Type II fleet error for active fleetwide talkgroup
  XX XX = 16–bit ID
  YY YY = talkgroup ID
  ZZ ZZ = fleet ID
55 XX XX – DRAM problem found in talk group–to–supergroup table during call processing
  XX XX = start of regrouped talkgroup block
56 XX XX YY – Received request with ID type in wrong range
  XX XX = 16–bit ID
  YY = call type
57 – Received a data channel request on a non–data system
58 – Received a Data End–of–Call request from a unit other than the Trunked Data Controller
59 XX XX YY – Received wide area request from local console
  XX XX = 16–bit ID
  YY = call type
60 XX XX YY YY ZZ ZZ – Dynamically regrouping announcement talkgroup that is not setup in database
  XX XX = 16–bit ID
  YY YY talkgroup ID
  ZZ ZZ fleet ID
61 – Ready bin not found on APC queues
62 – Time or Date ISW rejected due to gateway closed
63 CC – Unknown call type for ATA billing
  CC = Call type

TASK ID NUMBER: 07
TASK NAME: CHLWRK

01 – CHLWRK started with no work
02 – Illegal RSC command received
03 – Illegal device number in RSC command
04 – Command received for inactive RSC
05 – Command received with unknown source
06 – Illegal command received
07 – Illegal device number in TSC command
08 – Command received for inactive TSC
09 XX – Pending command on deassigned channel XX (hex)
0A XX – Previous AMSS call not cleaned up for channel XX
0B – Illegal intertask command received
0C – Illegal channel address in intertask command
0D – Intertask command received out of expected sequence
0E – Call started for a call type not yet serviced
0F XX CC DD FF TT RR II II – Abnormal call end
  XX = Channel number
  CC = Call type
  DD = D5 timer count
  FF = Flags
  TT = TIB status
  RR = RIB status
  II II = 16 bit ID

2.3.25 CSC (Central Site Controller)/ReSC (Remote Site Controller) (Cont)

DEVICE NO (HEX): E0

TASK ID NUMBER: 08
TASK NAME: EDMWRK

01 – EDMWRK started with no work to do
02 – EDMWRK started, but unknown command received
03 – Illegal device in status change command
04 – Device number out of range
05 – Set malfunction timeout to maximum to prevent Failsoft. All MALF RIBs due to illegal carrier, changed to enabled
06 – Tryed to end an AMAX call
07 – Tryed to do BSI but it was assigned
08 – Illegal device in BSI command
09 – 1st 3X command received and 1st one being held
0A – Received 2nd 3x bin and no 1st
0B – Bad data in individual–to–talkgroup affiliation table
0C LL WW SS TT – AMSS remote trunking status message
  LL = Local failsoft 40–4F reported from remote site see *REMOTE SITE GENERATED AMSS MESSAGES*
  WW = Widearea failsoft 40–4F reported from remote site ,see *REMOTE SITE GENERATED AMSS MESSAGES*
  SS = System failsoft 40–5F reported from master site, see *REMOTE AND PRIME SITE GENERATED AMSS MESSAGES*
  TT = Trunking Status
    01 – Wide Area Trunking
    02 – Local Trunking
    03 – Trunking
    04 – Wide Area Failsoft
    05 – Site Failsoft
    08 – Idle
0D – Received an alarm status when not an MCSC system type
0E – Received a site status change when the system type is a CSC
0F TT – AMSS remote site Trunking status change.
  TT = Trunking Status
    01 – Wide Area Trunking
    02 – Local Trunking
    03 – Trunking
    04 – Wide Area Failsoft
    05 – Site Failsoft
    06 – Causing failsoft
    07 – Isolated
    08 – Idle
10 – Central switched from IDLE to ACTIVE
11 – Central switched from ACTIVE TO IDLE
12 – Site status checksum error, all sites set to default
13 – Invalid site request received
14 TT – ATA memory alarm set
  TT = Reason for alarm
    01 – ATA storage space 90% used
    02 – ATA storage space 100% used
    03 – ATA read/write error
15 –
16 –
17 –
18 –
19 –
1A –
1B –
1C –
1D –
1E –
1F –
20 – Exit from failsoft
21 – Entered failsoft due to: no RSC link
22 –
23 – Entered failsoft due to: no IRB
24 – Entered failsoft due to: no TSC port
25 –
26 – Entered failsoft due to: no RIB for control
27 – Entered failsoft due to: no TIB for control
28 – Entered failsoft due to: no RIB FOR voice channel
29 – Entered failsoft due to: no TIB for voice channel
2A – entered failsoft due to: TCI reporting no TSC link
2B – Entered failsoft due to: TCI reporting no TIMI links
2C – Entered failsoft due to: no BIM for control

TASK ID NUMBER: 08 (CONT)
TASK NAME: EDMWRK

2D – Entered failsoft due to: no BIM for voice
2E – Entered failsoft due to: no TCI link
2F – Entered failsoft due to: no DCB link
30 – Entered failsoft due to: ReSC malfunction
31 – Entered failsoft due to: ReSC Composite Status Change
32 – Entered failsoft due to: Majority of Channel Failure
33 – Entered failsoft due to: No Control Channels at a Remote
2D – Entered failsoft due to: no BIM for voice
2E – Entered failsoft due to: no TCI link
2F – Entered failsoft due to: no DCB link
30 – Entered failsoft due to: ReSC malfunction
31 – Entered failsoft due to: ReSC Composite Status Change
32 – Entered failsoft due to: Majority of Channel Failure
34 – Entered failsoft due to: ReSC CRB malfunction
35 – Entered failsoft due to: ReSC Link failures
36 – Entered failsoft due to: all ReSC are disabled or malf
38 – Entered fail soft due to: no TCI/RSC link
39 – Entered failsoft due to: no TCI/DCB link
3A – entered failsoft due to: ReSC link malf
3B – Entered failsoft due to: no RTIB for control
3C – Entered failsoft due to: no RTIB for voice

REMOTE SITE GENERATED AMSS MESSAGES

40 – Entered failsoft due to: remote audio status bad
41 – Entered failsoft due to: remote link malfunction (RCSC, DCB)
42 – Entered failsoft due to: remote link malfunction (RCSC, RSC)
43 – Entered failsoft due to: remote link malfunction (RCSC, TCI)
44 – Entered failsoft due to: remote link malfunction (TCI,RSC)
45 – Entered failsoft due to: remote link malfunction (TCI read only link)
46 – Entered failsoft due to: remote link malfunction (RCSC, TSC)
47 – Entered failsoft due to: remote TCI reporting no TIMI links
48 – Entered failsoft due to: remote IRB malfunction
49 – Entered failsoft due to: no RIB for a control channel
4A – Entered failsoft due to: no TIB FOR a control channel
4B – Entered failsoft due to: no wide area RIB for voice channel
4C – Entered failsoft due to: no wide area TIB for voice channel
4D – Entered failsoft due to: no local RIB for a voice channel
4E – Entered failsoft due to: no local TIB for a voice channel
4F – Entered failsoft due to: no local BIM for a voice channel

PRIME SITE GENERATED AMSS MESSAGES

51 – Entered failsoft due to: remote link malfunction (RCSC, DCB)
52 – Entered failsoft due to: prime link malfunction (MCSC, DCB1)
53 – Entered failsoft due to: prime link malfunction (MCSC, TCI)
54 – Entered failsoft due to: prime link malfunction (TCI, DCB)
55 – Entered failsoft due to: prime link malfunction (TCI read–only link)
56 – Entered failsoft due to: prime link malfunction (MCSC, DCB2)
57 – Entered failsoft due to: prime TCI reporting no TIMI links
58 – Entered failsoft due to: all remote sites are in limited mode
59 – Entered failsoft due to: no RIB for wide area voice channel at the prime
5A – Entered failsoft due to: no TIB for wide area voice channel at the prime
5B – Entered failsoft due to: no BIM for wide area voice channel at the prime

TASK ID NUMBER: 09
TASK NAME: LOGGER

01 – Dispatch busy/call length not calculated, abnormal length

2.3.25 CSC (Central Site Controller)/ReSC (Remote Site Controller) (Cont)

DEVICE NO (HEX): E0

TASK ID NUMBER: 0A
TASK NAME: USESUB

---

01 – Priority level not valid, set to default
02 – Subscriber not active or enabled
03 – Duplicate bins purged from system manager queue
04 – Invalid bin address for bin to be released to available queue
05 – Bad codeplug default password
06 – Invalid command sent to USEWRK
07 – Unsupported command sent to USEWRK
08 – Password table corrupted
09 – Invalid logon attempt
0A – SIMS priority change checksum error
0B – Invalid priority value from SIMS
0C – SAC database lost during execution of "SAC" command

TASK ID NUMBER: 0E
TASK NAME: NMIWRK

---

01 – Time data lost
02 – Misc. parameter data lost
03 – EDMWRK status data lost
04 – LOGGER WEEKDAY parameters lost
05 – LOGGER WEEKEND parameters lost
06 – LOGGER SUMMARY data lost
07 – ISWOSW NEGS list lost
08 – A value in PARM was too low
09 PP AA AA – DRAM malfunction in SAC database
    PP = DRAM page number
    AA AA = address of malfunction
0A – ISR data lost on default page of DRAM
0B – ISR data lost on an alternate page of DRAM
0C – Fleet-subfleet/talk group SAC data lost
0D –
0E – SAC data lost and SAC turned off
0F – SAC defaults and status lost
10 – Passwords lost and set to default
11 – Codeplug passwords corrupted and set to null
12 – Bad DRAM found in password area. No password needed to log into system manager terminal
13 –
14 – All or some talkgroup to fleet affiliation lost
15 – All or some individual to talkgroup affiliations lost
16 – DRAM malfunction while performing affiliation error detection
17 – Dynamic regrouping table & checksum byte cleared due to checksum error
18 – Too many talkgroups set up in the prefix/sizecode table for the amount of DRAM (codeplug error)
19 – Weekday dispatch timeout table lost
1A – Weekend dispatch timeout table lost
1B – Protect table bad – Shared User Group info lost
1C – Interconnect table bad – Shared User Group info lost
1D – Dispatch table bad – Shared User Group info lost

2.3.26 Redundant Link

DEVICE NO (HEX): EB

TASK ID NUMBER: 00
TASK NAME: RDLWRK

---

01 – Unknown command received
02 – This link has detected a DCD error
03 – No CTS on this port
04 – This link has detected a framing error
05 – This link has detected an overrun error
06 – This link has detected a parity error
07 – Link error received
08 – Link failure due to lack of receive data
09 – ECHO sync was lost on this link
0A – Receive checksum error for this link
0B – Receiver buffer overflow for this link
0C – Unknown ACIA error for this link
0D – Bad sequence number for EHL
0E – Bad response tag
0F – ACIA reset due to DCD ERRORS
10 – Sent queue overflow for this link
11 – Link enabled
12 – Unknown redundant link opcode received
13 – Bad data in individual to talkgroup affiliation database
14 – Status of link after ACB push button switch change

2.3.27 ReSC-ACB Link

DEVICE NO (HEX): EF

TASK ID NUMBER: 00
TASK NAME:

2F – Status of link after front panel change; condition shows current status

2.3.28 SIB (Site Interface Board)

DEVICE NO (HEX): F0–FE

TASK ID NUMBER: 00
TASK NAME:

---

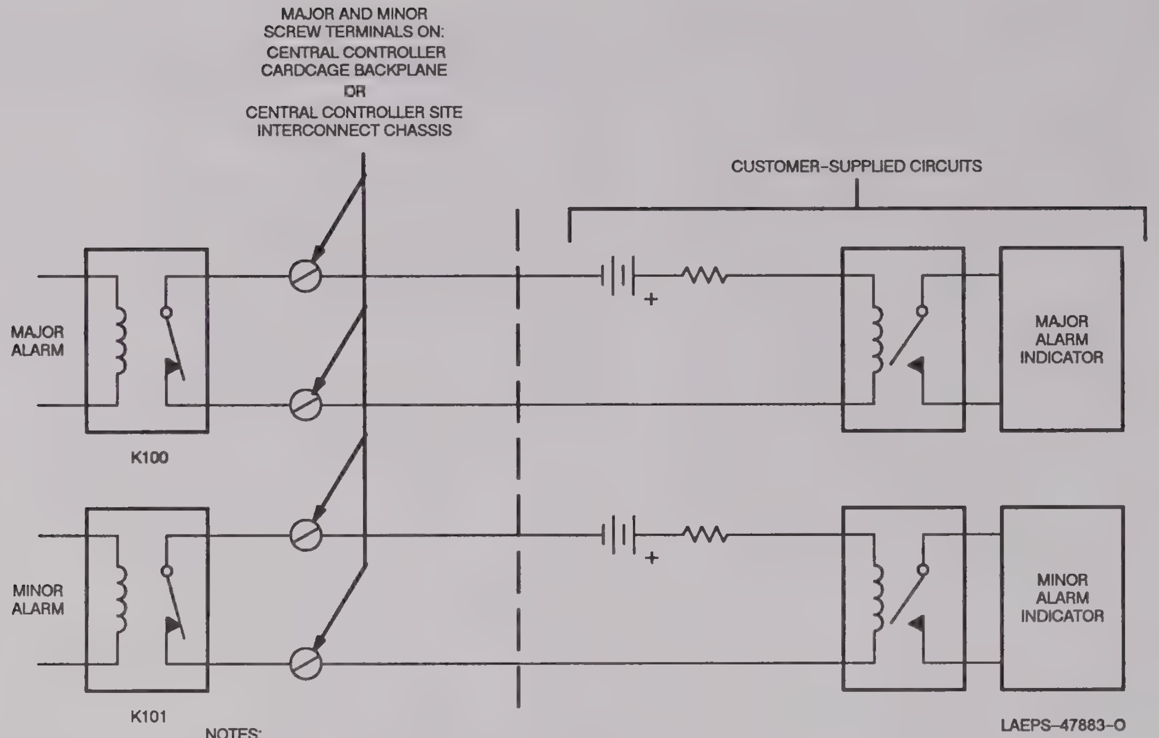
20 – No malfunction status
21 – Audio path status mismatch
22 – Audio control hardware unable to break audio
23 – Audio control hardware unable to break audio and audio path status mismatch
24 – Audio control hardware unable to connect audio
25 – Audio control hardware unable to connect audio and audio path status mismatch
26 – Audio control hardware unable to connect audio and audio control hardware unable to break audio
27 – Audio control hardware unable to connect audio, audio control hardware unable to break audio, and audio path status mismatch

2.4 DIAGNOSTIC MESSAGE GLOSSARY

Refer to Table 1.

Table 1. Glossary

Acronym	Description	Acronym	Description
ACB	Asynchronous Communications Board	MCSC	Master Central Site Controller
ACIA	Asynchronous Communications Interface Adapter	MI	Main Central, Idle
ADCB	AMSS Data Concentrator Board	NEGS	Negative Suscriber Access
AMSS	Automatic Multiple Site Select	NMIWRK	Non–maskable Interrupt Work
APC	Advance Private Queue	NXTOSW	Next Outbound Signaling Word
ATA	Air–Time Accumulator	OSW	Outbound Signaling Word
BA	Backup Central, Active	PARM	Parameter
BI	Backup Central, Idle	PLIB	Phone Line Interface Board
BIM	Base Interface Module	PMINTF	Prime Interface
BSI	Base Station Identifier	PTT	Push–To–Talk
CACB	CSC Asynchronous Communications Board	RACB	ReSC Asynchronous Communications Board
CHLPRC	Channel Processor	RCMD	Receive Command
CHLWRK	Channel Work	RCSC	Remote Central Site Controller
CLLPRC	Call Processor	RDLWRK	Receive Delay Work
CMD	Command	ReSC	Remote Site Controller
CRB	Clock Recovery Board	RMINTF	Remote Interface
CSC	Central Site Controller	RSC	Receiver Site Controller
CTS	Clear–to–Send	RSTFLG	Reset Flag
CURICU	Current ICU Count	RTIB	Remote Transmitter Interface Board
CURSP	Current Phone Count	SAB	Site Audio Board
DACB	DCB Asynchronous Communications Board	SAC	Subscriber Access Control
DCB	Data Concentrator Board	SIB	Site Interface Board
DCD	Data Carrier Detect	SIMS	*SMARTNET* Information Management System
DRAM	Dynamic RAM	SMT	System Manager Terminal
EDM	Enable/Disable Malfunction Work	TACB	TCI Asynchronous Communications Board
EDMPRC	EDM Processor	TBIM	Trunked Base Station Interface Module
EDMWRK	EDM Work	TBLACC	Table Access
EHL	Error Handling Link	TCI	Trunked Console Interface
FRF	Fast Radio Finder	TDC	Trunked Data Controller
ICU	Interconnect Unit	TIB	Transmitter Interface Board
INQWRK	In Queue Work	TIMI	Trunked I/O Multiplexed Interface
INTFRX	Receive Interface Routine	TONPRC	Tone Processor
INTFTX	Transmit Interface Routine	TRIB	Telephone Repeater Interface Board
IRB	Inbound Recovery Board	TSC	Transmitter Site Controller
ISR	Individual SAC Records	TSTAT	Transmitter Status
ISW	Inbound Signaling Word	USESUB	User Subroutine
MA	Main Central, Active	USEWRK	User Work
MALF	Malfunction	VIDPRC	Valid ID Processor
MCB	Master Control Board		


MAJOR AND MINOR SCREW TERMINALS ON: CENTRAL CONTROLLER CARDCAGE BACKPLANE OR CENTRAL CONTROLLER SITE INTERCONNECT CHASSIS
CUSTOMER-SUPPLIED CIRCUITS
MAJOR ALARM
K100
MINOR ALARM
K101
+
+
MAJOR ALARM INDICATOR
MINOR ALARM INDICATOR
LAEPS-47883-O

NOTES:

1. ALL RELAYS ARE SHOWN ENERGIZED (NON-ALARM CONDITION).
2. CENTRAL CONTROLLER K100 AND K101 CONTACTS RATED FOR 28 V DC @ 100 MA.

Figure 2. Typical External Alarm Connections

3. RELAY-ACTIVATED EXTERNAL ALARMS

The central controller is provided with two sets of dry-contact relay outputs labeled MAJOR ALARM and MINOR ALARM. Refer to Figure 2 and to the INSTALLATION portion of the central controller instruction manual. Both sets of relay contacts are normally closed (energized), indicating a non-alarm condition. With alarm occurrence, the corresponding relay contacts open.

MAJOR ALARM relay contacts open with the following malfunctions.

- Loss of ac power to the central controller.
- Loss of one or more of the dc power voltages.
- Failure of the CSC, RSC, or TSC site controller boards or loss of communications with any of these boards.
- Failure of the IRB (inbound recovery board).
- Failsoft operation.

The MAJOR ALARM can be cleared only by setting the site controller front panel **SERVICE ENABLE** key switch to the **SERVICE** position or by resetting the site controller board.

MINOR ALARM relay contacts open with the following malfunctions.

- Voice channel transmitter failure.
- Tone detector failure on RIB (receiver interface board)
- MCB (master control board) failure or loss of MCB communications.
- ATA (air-time accumulator) has activated a minor alarm.

The MINOR ALARM is cleared when the source of the alarm is no longer present. Alarms are functional only when the site controller boards are in the RUN mode.

External alarm relay contact characteristics are:

- Maximum current rating: 100 milliamperes
- Maximum voltage rating: 28 V dc.

Motorola does not supply external alarm devices, but any suitable devices may be used as long as they operate within the specified current and voltage ratings.

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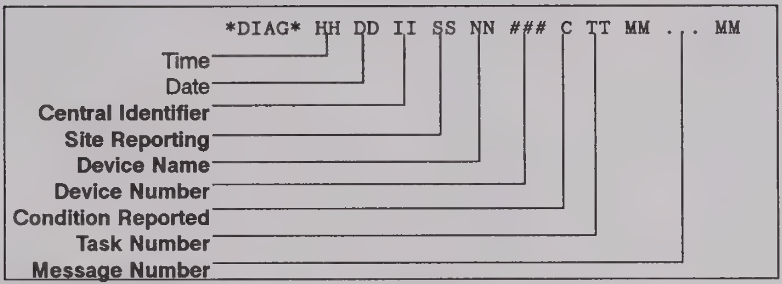
AUTOMATIC SYSTEM ALARM CAPABILITY

SMARTNET II+, *Privacy Plus–Enhanced* and
Privacy Plus–SE with AMSS Models



Central Identifier
Specifies reporting Central and its Active/Idle Status

MA : Main Central, Active
MI : Main Central, Idle
BA : Backup Central, Active
BI : Backup Central, Idle

Site Reporting
00 : Main Site
01–99 : Remote Sites

Device Name
Specifies device referred to in message by name; xx indicates channel or port no.

ADCB : AMSS Data Concentrator Board
BIM xx : Base Interface Module
CACB xx : CSC Async Comm Board
CRB : Clock Recovery Board
CSC : Central Site Controller
DACB xx : DCB Async Comm Board
DCB : Simulcast Data Concentrator Board
ICU – Interconnect Control Unit
IRB : Inbound Recovery Board
MCB : Master Control Board
PLIB xx : Phone Line Interface Board
ReSC : Remote Site Controller
RIB xx : Receiver Interface Board
RSC : Receiver Site Controller
RTIB xx : Remote Transmitter Interface Board

Device Name (Cont'd)
SIB – Site Interface Board
SAB – Site Audio Board
TACB xx : TCI Async Comm Board
TCI : Trunked Console Interface
TDC – Trunked Data Controller
TIB xx : Transmitter Interface Board
TIMI – Trunked I/O Multiplexed Interface
TRIB xx : Telephone Repeater Interface Board
TSC : Transmitter Site Controller

Device Number (Hex)
Specifies the subsystem or interface referred to in the message. First digit:
'o' = non-multiplex device;
'1' = multiplex device

000–01B : Base Interface Modules
020 : TIMI (Trunked I/O Multiplexed Interface)
021 : Trunked Console Interface
022 : TIMI – Active (Trunked Interface Module Interface)
023 : TCI–TSC Link
024 : TDC
025 : VME Controller
030–04B : Receiver Interface Boards
055 : Receiver Site Controller
056 : Inbound Recovery Board
057 : Clock Recovery Board

Device Number (Hex) (Cont'd)
058 : Remote Site Controller
059 : Site Audio Board
05A, 05B : AMSS Remote Site Controllers
060–07B : Transmitter Interface Boards
07F : Transmitter Site Controller
080–089 : TACB Interfaces
090 : Data Concentrator Board
091–09A : DACB Interfaces
09B : TCI–DCB Link
09C : CSC – AMSS DCB1 Link
09D : CSC – AMSS DCB2 Link
09E : ReSC–DCB Link
09F : AMSS Data Concentrator Board
0A0–0B7 : Telephone Repeater Interfaces
0B8 : Master Control Board/ Interconnect Control Unit
0B9–0D7 : Phone Line Interfaces
0E0 : Central Site Controller
0E1–0EA : CACB Interface
0EB : Redundant Link
0EF: ReSC–ACB Link
0F0–0FE : Site Interface Board
130–14B : Remote TIBs

Condition Reported (Hex)
Specifies the general type of action

04 : Link Failure
05 : Link Enable
0A : Enable Device
0B : Disable Device
0C : Malfunction Device
0D : Information Message
0E : Diagnose Device
0F : Error Message

Task Number (Hex)
Specifies the software task within the specified reporting device

Message Number (Hex)
Specifies the actual failure or action taken; definitions may vary for each reporting device. Most messages contain a single number but two or more may be issued.

Figure 1. Error Message Format

1. INTRODUCTION

The central controller is designed to alert the system manager when certain central controller or repeater malfunctions occur. This is done in two ways. One is the automatic generation of diagnostic messages on the system manager's terminal (with the system manager's terminal connected to the central controller and in the active mode). The other way is activation of an external alarm device by means of relay contacts triggered by failures reported to the central controller. No external alarm device is supplied with the central controller, however relay contacts are provided. For external alarm connection details, refer to paragraph 3.

The central controller generates error messages in the standard format shown in Figure 1.

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2. SYSTEM MANAGER TERMINAL ALARM MESSAGES

2.1 GENERAL

The system manager terminal automatically prints out alarm messages if, and only if, the following conditions are met:

for all models

- The central controller is active or idle.
- A central controller–detectable malfunction occurs in either the central controller or a base–repeater station.
- Diagnostic mode is automatic, i.e., 1) the AUTOMATIC command was issued to the DIAG subsystem, 2) the MANUAL command was never given after the system was first started, or 3) after a system memory loss.

for models with telephone interconnect

- The system manager terminal is connected to the central interconnect terminal and is in the active mode.
- The central interconnect terminal is active.

for models without telephone interconnect

- The system manager terminal is connected to the central controller and is in the active or idle mode.

2.2 MESSAGE EXAMPLES

Examples:

```
*DIAG* 00:00:00 01/01/86 MA 00 CSC 0E0 F 08 21
```

Central/Status : Main/Active
Site : Prime
Device Name : CSC
Device Number : 0E0
Condition Reported : 0F - Error Message
Task Number : 08
Message Number : 21 - Entered failsoft due to no RSC link

```
*DIAG* 00:00:00 01/01/86 BI 00 RIB 11 03A C 00 25
```

Central/Status : Backup/Idle
Site : Prime
Device Name : RIB 11
Device Number : 03A
Condition Reported : 0C - Malfunction Device
Task Number : 00
Message Number : 25 - Disconnect tone failure

2.3 ERROR MESSAGES

2.3.1 BIM (Base Interface Module)

DEVICE NO (HEX): **000 – 01B**

TASK ID NUMBER: **00**
TASK NAME:

00 – BIM status change; condition shows current status.

2.3.2 TIMI (Trunk Interface Module Interface)

DEVICE NO (HEX): **020**

TASK ID NUMBER: **00**
TASK NAME:

00 – TIMI link status change; condition shows current status.

2.3.3 TCI (Trunked Console Interface)

DEVICE NO (HEX): **021**

TASK ID NUMBER: **00**
TASK NAME: **Interface**

01 – TCI Restart – lack of tickle or manual reset.
02 – TCI Restart – power fail.
03 – TCI Restart – DRAM checksum error.
04 – TCI Restart – diagnostic received test started.
05 – TCI Restart – no short bins.
06 – TCI Restart – no long bins.
07 – TCI Restart – lost link to CSC.

10 – Link enabled.
11 –
12 – This link has detected a DCD error.
13 – No CTS on this port.
14 – This link has detected a framing error.
15 – This link has detected a over–run error.
16 – This link has detected a parity error.
17 –
18 –
19 – ECHO sync was lost from device.
1A – Receive checksum error for this link.
1B – Receiver buffer overflow for this link.
1C – Unknown ACIA error for this link.
1D – Sent queue overflow for this link.

TASK ID NUMBER: **01**
TASK NAME: **SRVDEV**

08 – Invalid opcode for an EDM command.
09 – Invalid device number for an EDM command.
0A – EDM command received from CSC with nothing pending.

TASK ID NUMBER: **02**
TASK NAME: **SRVMSC**

08 – Invalid opcode for an EDM command.
09 – Invalid device number for an EDM command.
0B – Invalid PARM received from CSC.

2.3.3 TCI (Trunked Console Interface) (Cont)

DEVICE NO (HEX): **021**

TASK ID NUMBER: **03**
TASK NAME: **ISWPRC**

0D – 1st word ISW received but no 2nd word..
0E – 2nd word ISW received but no 1st word.
0F – Bad ID in regroup request.

TASK ID NUMBER: 04
TASK NAME: OSWPRC

11 – Bad OSW opcode.

TASK ID NUMBER: 05
TASK NAME: CHLPRC

0C – Channel processor received an invalid opcode..

2.3.4 TCI/TSC (Trunked Console Interface/ Transmitter Site Controller)

DEVICE NO (HEX): 023

TASK ID NUMBER: 00
TASK NAME:

00 – TCI/TSC status change; condition shows current status.

2.3.5 TDC (Trunked Data Controller)

DEVICE NO (HEX): 024

TASK ID NUMBER: 00
TASK NAME: Generic

08 – TCI–TDC link enabled and entering Data Fully-Operational Mode.
09 – TCI–TDC link disabled and entering Data Reduced-Operation Mode.

2.3.6 RIB (Receiver Interface Board)

DEVICE NO (HEX): 030 –04B

TASK ID NUMBER: 00/01
TASK NAME: Generic/EDM

20 – Device status; condition shows current status..
23 – High speed tone test failure
24 – Low speed tone test failure
25 – Disconnect tone failure
26 – Illegal carrier malfunction
2D – RIB(/RTIB) status change due to a site removed from service.
2F – Front panel switch change; condition shows current status.
30 –
31 –

2.3.7 RSC (Receiver Site Controller)

DEVICE NO (HEX): 055

TASK ID NUMBER: 00
TASK NAME: Generic

01 – RSC restart – lack of tickle.
02 – RSC restart – power fail.
03 – RSC restart – lost battery–backed RAM.
04 – RSC restart – test started.
05 – RSC restart – ACIA error.
06 – RSC restart – BIN error.
07 – CSC assigned an already assigned channel (INQWRK).
08 – CSC sent an unknown PARM (INQWRK).
09 – Unknown opcode error (INQWRK).
0A –
0B –
0C – Device number out of range (INQWRK).
0D –
0E –
0F –
10 – RSC–CSC link enabled.
11 –
12 – This link has detected a DCD error.
13 – No CTS on the this port.
14 – This link has detected a framing error.
15 – This link has detected a overrun error.
16 – This link has detected a parity error.
17 –
18 –
19 – ECHO sync was lost on the this link.
1A – Receive checksum error for this link.
1B – Receiver buffer overflow for this link.
1C – Unknown ACIA error for this link.
1D – Sent queue overflow for this link.
1E –
1F –

2.3.8 IRB (Inbound Recovery Board)

DEVICE NO (HEX): 056

TASK ID NUMBER: 00/01
TASK NAME: Generic

20 – Device status; condition shows current status.
21 – IRB interrupt failure.
22 – IRB double buffer failure.
2D – IRB(/CRB) status change due to a site removed from service.

2.3.9 CRB (Clock Recovery Board)

DEVICE NO (HEX): 057

TASK ID NUMBER: 01
TASK NAME: EDM

20 – Device status; condition shows current status.
2B – Malfunction due to test failure.
2D – IRB(/CRB) status change due to a site removed from service.

2.3.10 ReSC (Remote Site Controller)

DEVICE NO (HEX): 058

TASK ID NUMBER: 00
TASK NAME: RCMD

---

01 – ReSC restart – lack of tickle.
02 – ReSC restart – power fail.
03 – ReSC restart – lost battery–backed RAM.
04 – ReSC restart – diagnostic receive test started.
05 – ReSC restart – lost DCB link..
06 – ReSC restart – BIN error.

……

TASK ID NUMBER: 01
TASK NAME: RCMD

---

07 – Assigned a previously assigned channel.
08 – Illegal PARM received.
09 – Unknown command.
0A –
0B – Illegal device address: ENABLE
0C – Illegal device address: DISABLE
0D – Illegal device address: STATUS REQUEST
0E – Illegal device address: CHANNEL COMMAND
0F – Illegal device address: MALFUNCTION
30 – Illegal device address: DIAGNOSTIC
31 – Illegal device address: DATA TRANSFER
32 – Received XMIT CMD for front–panel disabled RTIB.
33 – Illegal channel number: DEASSIGNMENT (09 command)
34 – Illegal channel number: ASSIGNMENT (09 command)
35 – Assigning a channel with RIB or RTIB not enabled.
36 – Deassigning a deassigned RIB.
37 – Illegal device address in key, dekey, mute or unmute.
38 – Received key or dekey for disabled RTIB.
3D – All Remotes removed from service.
40 – No message.
41 – ReSC composite status change due to a site removed from service.
42 – ReSC Malfunction: Majority of channels out of service.
43 – ReSC Malfunction: All control channels out of service.
44 – ReSC Malfunction: CRB has lost lock on the control channel.
45 – ReSC Malfunction: DCB to ReSC link has malfunctioned.
47 – ReSC status change due to Idle/Active hardware change.
4F – ReSC disabled at ReSC front panel.

2.3.11 SAB (Site Audio Board)

DEVICE NO (HEX): 59

TASK ID NUMBER: 00
TASK NAME:

---

00 – SAB status change; condition shows current status.
01 – Reset flag (RSTFLG) initialization
02 – Power loss indicated.
03 – Invalid SAB device.
04 – Diagnostic restart.
05 – Reset due to ACIA error.
06 – BIN error.
07 – Invalid SIB device number.
09 – Unknown command received.
12 – DCD Interrupt detect.
14 – ACIA Framing error.
15 – ACIA Overrun error.
16 – ACIA Parity error.
1A – Checksum error on ACIA.
1C – Unknown ACIA error.

2.3.12 TIB (Transmitter Interface Board)

DEVICE NO (HEX): 060–07B

TASK ID NUMBER: 00
TASK NAME: Generic

---

20 – Device status; condition shows current status.
21 – No TSTAT indication during test.
22 – TSTAT indication when not keyed (red light failure).
23 – No TSTAT during a call.
24 –
25 – Control channel failed test due to lack of TSTAT.
26 –
27 –
28 –
29 –
2A –
2B –
2C –
2D –
2E –
2F – Front panel switch change; condition shows current status.

2.3.13 TSC (Transmitter Site Controller)

DEVICE NO (HEX): 07F

TASK ID NUMBER: 00
TASK NAME: Generic

---

01 – TSC restart – lack of tickle.
02 – TSC restart – power fail.
03 – TSC restart – lost battery–backed RAM.
04 – TSC restart – test started.
05 – TSC restart – ACIA error.
06 – TSC restart – BIN error.
07 – Repeat OSW for dekeyed channel.
08 – High speed data buffer overrun.
09 – Unknown Opcode.
0A – Buffer load not complete.
0B – OSW data buffer overrun.
0C – Channel number out of range.
0D – Channel command for disabled or malfunction channel.
0E – Illegal command for a control channel.
0F – Channel `IN OSW > 28` or channel out–of–range.
10 – TSC–CSC link enabled.
11 –
12 – This link has detected a DCD error.
13 – NO CTS on the this port.
14 – This link has detected a framing error.
15 – This link has detected an overrun error.
16 – This link has detected a parity error.
17 –
18 –
19 – ECHO sync was lost on this link.
1A – Receive checksum error for this link.
1B – Receiver buffer overflow for this link.
1C – Unknown ACIA error for this link.
1D – Sent queue overflow for this link.
1E –
1F –
30 – Did not get to priority work on this WFI.
31 – Count of FRF words in system fell below zero.

2.3.14 TACB (TCI Asynch Communications Board)

DEVICE NO (HEX): 080 – 089

TASK ID NUMBER: 01
TASK NAME:

---

10 xx – TIMI link status change; condition shows current status. xx = number of links in service.
2F xx – TIMI front panel switch change; condition shows current status. xx = number of links in service.

2.3.15 DCB (Simulcast Data Concentrator Board)

DEVICE NO (HEX): **090**

TASK ID NUMBER: **00**
TASK NAME: **Initialization**

---

01 – DCB restart – lack of tickle or manual reset.
02 – DCB restart – power fail.
03 – DCB restart – lost battery–backed RAM.
04 – DCB restart – diagnostic received test started.
05 – DCB restart – lost CSC (TCI) link.
06 – DCB restart – BIN error.
07 – DCB Restart – invalid interrupt request.
10 – DCB link enabled.
11 –
12 – This link has detected a DCD error.
13 – NO CTS on this port.
14 – This link has detected a framing error.
15 – This link has detected an overrun error.
16 – This link has detected a parity error.
17 –
18 –
19 – ECHO sync was lost on the this link.
1A – Receive checksum error for this link.
1B – Receiver buffer overflow for this link.
1C – Unknown ACIA error for this link.
1D – Sent queue overflow for this link.
1E –
1F –

TASK ID NUMBER: **01**
TASK NAME: **EDMPRC**

---

08 – Illegal data transfer (PARM).
09 – Unknown command from prim e site.
0A – Unknown command from remote site.
0B – Illegal source site for tone status update.
0C –
0D –
0E –
0F – Illegal lock command.
32 – Remote device status from CSC.
33 – Invalid site ID given for conversion.
36 – Illegal control channel update.
3D – ReSC status mismatch in status response.
3E – IRB status mismatch in status response.
3F – RIB status mismatch in status response.
40 – Remote update from master CSC while locked enabled.
41 – Remote update from master CSC while locked disabled.
42 – Remote update from master CSC while locked malfunctioned.
43 – Malfunction lost after confirmation.
44 – Address of site malfunction lost.
45 – Malfunction lost before confirmation.
46 – Remote MALFUNCTIONED due to CONTROL CHANNEL failure.
47 – Received invalid unrequested EDM command.
48 –
49 –
4A – Some status update with device locked enabled.
4B – Some status update with device locked disabled.
4C – Some status update with device locked malfunctioned.

TASK ID NUMBER: **02**
TASK NAME: **TBLACC**

---

07 – Invalid site id to convert.
0C – Invalid device number to convert.
38 – Weight conversion to command error.
39 – Command conversion to weight error.

TASK ID NUMBER: **03**
TASK NAME: **TONPRC**

0A –
0B – Illegal site for tone status update.
0C –
0D – Inappropriate device number for tone update.
34 – Tone update with ReSC not enabled.
35 – Tone update with RIB/TIB not enabled.
36 –
37 – Tone table conversion error.

TASK ID NUMBER: **04**
TASK NAME: **PMINTF**

0E – Bad BIN from prime interface.
3A – DCB detected prime interface failure.

TASK ID NUMBER: **05**
TASK NAME: **RMINTF**

---

30 – Remote link up.
31 – Remote link failure due to lack of received data.

TASK ID NUMBER: **07**
TASK NAME:

---

48 – Invalid 3X command length requested.

2.3.16 DACB (DCB Asynchronous Communications Board)

DEVICE NO (HEX): **091–09A**

TASK ID NUMBER: **06**
TASK NAME:

2F – Front panel switch change; condition shows current status.

2.3.17 TCI/DCB Link

DEVICE NO (HEX): **09B**

TASK ID NUMBER: **00**
TASK NAME:

---

10 – Link status change; condition shows current status.
11 –
12 – This link has detected a DCD error.
13 – NO CTS on the this port.
14 – This link has detected a framing error.
15 – This link has detected an overrun error.
16 – This link has detected a parity error.
17 –
18 –
19 – ECHO sync was lost for this link.
1A – Receive checksum error for this link.
1B – Receiver buffer overflow for this link.
1C – Unknown ACIA error for this link.
1D – Sent queue overflow for this link.
1E –
1F –

2.3.18 CSC – AMSS DCB2 Link

DEVICE NO (HEX): 09D

TASK ID NUMBER: 00
TASK NAME:

10 – Link status change; condition shows current status.
11 –
12 – This link has detected a DCD error.
13 – NO CTS on the this port.
14 – This link has detected a framing error.
15 – This link has detected an overrun error.
16 – This link has detected a parity error.
17 –
18 –
19 – ECHO sync was lost for this link.
1A – Receive checksum error for this link.
1B – Receiver buffer overflow for this link.
1C – Unknown ACIA error for this link.
1D – Sent queue overflow for this link.
1E –
1F –

2.3.19 ReSC/DCB2 Link (from ReSC side)

DEVICE NO (HEX): 09E

TASK ID NUMBER: 05
TASK NAME: RMINTF

10 – Link enabled.
18 – Link failure due to lack of valid data.

2.3.20 ADCB (AMSS Data Concentrator Board)

DEVICE NO (HEX): 09F

TASK ID NUMBER: 00
TASK NAME: INIT

01 – DCB restart – lack of tickle or manual reset.
02 – DCB restart – power fail.
03 – DCB restart – lost battery-backed RAM.
04 – DCB restart – diagnostic received test started.
05 – DCB restart – lost CSC (TCI) link.
06 – DCB restart – BIN error.
07 – DCB Restart – invalid interrupt request.
10 – Link status change; condition shows current status.
11 –
12 – This link has detected a DCD error.
13 – NO CTS on this port.
14 – This link has detected a framing error.
15 – This link has detected an overrun error.
16 – This link has detected a parity error.
17 –
18 –
19 – ECHO sync was lost on the this link.
1A – Receive checksum error for this link.
1B – Receiver buffer overflow for this link.
1C – Unknown ACIA error for this link.
1D – Sent queue overflow for this link.
1E –
1F –

TASK ID NUMBER: 01
TASK NAME: EDMPRC

08 – Invalid source for EDM command. xx = Opcode, yy = Device, zz = Site/Reason code.
09 – Unknown EDM opcode received. xx = Invalid opcode.
0A – Invalid source for site status command.
0F – Invalid site status code received. xx = Invalid status code.
2E – Status change due to RCSC added/removed from wide area.
32 – Invalid site for status command. xx = Invalid site number.
36 – Invalid control channel update.
3B – Invalid source for PARM command.
3C – Invalid PARM number received. xx = Invalid PARM number.
3D – Invalid source for BSI command.
3E – Invalid channel for BSI command. xx = Invalid channel number.
3F – Invalid EDM device received. xx = Invalid device number.
40 – Invalid source for RIB/TIB command.
41 – Invalid source for RCSC command.
42 – Invalid source for DCB command.
43 – Invalid opcode for DCB command. xx = Invalid opcode.
44 – Invalid device for audio status command. xx = Invalid device number.
45 – Invalid source for SAB command.
46 – Invalid opcode for SAB command. xx = Invalid opcode.
47 – Invalid opcode for unexpected RIB/TIB command. xx = Invalid opcode.
49 – Invalid opcode for RCSC failsoft command. xx = Invalid opcode.
4A – Invalid opcode for MCSC failsoft command. xx = Invalid opcode.
4B – Invalid source for SIB command.
4C – Invalid opcode for SIB command.
4D – Invalid source for power up complete command.

TASK ID NUMBER: 02
TASK NAME: TBLACC

33 – Invalid site id to convert.
38 – Weight conversion to command error.
39 – Command conversion to weight error.

TASK ID NUMBER: 03
TASK NAME: CHLPRC

0B – Illegal source site for tone status update.
0D – Inappropriate device number for tone update. xx = Invalid device number.
37 – Tone table conversion error.

TASK ID NUMBER: 04
TASK NAME: PMINTF

0E – Bad bin from prime interface.
4D – ADCB detected RSC interface failure.
4E – ADCB detected TSC interface failure.

TASK ID NUMBER: 06
TASK NAME: ABACK

3A – Invalid LED state requested.

2.3.20 ADCB (AMSS Data Concentrator Board) (Cont)

DEVICE NO (HEX): **09F**
TASK ID NUMBER: **07**
TASK NAME: **GEN3X**

48 – Invalid 3x command length requested.

TASK ID NUMBER: **08**
TASK NAME: **C3XPRC**

50 – Invalid source for 3x command.
51 – Invalid type of 3x command received. xx = Invalid 3x type.
52 – Second of two 3x commands not received.
53 – Two first of two 3x commands received.
54 – Second of two 3x commands received without first.

TASK ID NUMBER: **09**
TASK NAME: **CLLPRC**

0C – Re-assignment received for a channel not assigned. xx = Channel number.
30 – Invalid call opcode received. xx = Invalid opcode.
34 – Invalid source number for call command.
35 – Invalid channel for call command; xx = Channel number.

2.3.21 TRIB (Telephone Repeater Interface Board)

DEVICE NO (HEX): **0A0–0B7**

TASK ID NUMBER: **00**
TASK NAME:

2D – New assignment to a TRIB that is already assigned.
2E – Alert tone command from unassigned TRIB.
2F – Front panel switch change; condition shows current status.
31 – Aborting a call assigned to an unassigned TRIB.

2.3.22 MCB/ICU (Master Control Board/ Interconnect Unit)

DEVICE NO (HEX): **0B8**
TASK ID NUMBER: **00**
TASK NAME:

01 XZ MM LL – ICU restart – lack of tickle
02 XZ MM LL – ICU restart – power failure reset
03 XZ MM LL – ICU restart – battery-backed ram lost
04 XZ MM LL – ICU restart – test request reset
05 XZ MM LL – ICU restart – ACIA error
06 XZ MM LL – ICU restart – BIN error
07 XZ MM LL – ICU restart – error in dynamic RAM

X = F = Authorization Inactive
0 = Authorization Active
Z = F = Billing not initialized
0 = Billing Initialized
MM = 00 = Memory Test Passed
F1 = Static RAM checksum error
F2 = Dynamic RAM checksum error
LL = 00 = Long distance memory checksum correct
0A – Minor matrix malfunction.
0B – Cut-through relay malfunction.
0D – Matrix vertical failure.
10 – MCB-CSC link enabled.
12 – This link has detected a DCD error.
13 – NO CTS on the this port.
14 – This link has detected a framing error.

TASK ID NUMBER: **00 (CONT)**
TASK NAME:

15 – This link has detected an overrun error.
16 – This link has detected a parity error.
19 – ECHO sync was lost for this link.
1A – Receive checksum error for this link.
1B – Receiver buffer overflow for this link.
1C – Unknown ACIA error for this link.
1D – Sent queue overflow for this link.
2B – Long distance call log 75% full, time to list and delete.
2C – Long distance call log full. Long distance calling disabled.
32 – Roamer ID conflict, local users deleted..
33 – Sixteen bytes of DRAM have been corrupted.
34 – A bin error in DRAM has occurred.
35 – Long distance call log error. Records cleared.
36 – Unknown MCB command from CSC.
37 – Invalid opcode in command from CSC.
38 – Invalid byte count in MCB task command.
39 – Unknown OSW command from CSC.
3A – Alert tone command for non-voice phase call.
3B – ICU decrement command abort.
3C – The CSC sent a call grant for an ID already on a call.
3D – RING OSW received for a call in the terminate phase.
3E – Could not find the call ID for RING OSW.
3F – RING OSW for a non-land-to-mobile call.
40 –
41 – L-to-M call skipped WAIT phase before RING phase.
42 – Additional diagnostic CMD from CSC, but test completed.

2.3.23 PLIB (Phone Line Interface Board)

DEVICE NO (HEX): **B9–D7**

TASK ID NUMBER: **00**
TASK NAME:

07 – Dialtone detect failure.
08 – Audio synthesizer malfunction.
09 – DTMF decoder malfunction.
0C – Multiple PLIB malfunction.
21 – GLARE collision on land to mobile call.
22 – STOPPED RINGING status from off-hook and assigned PLIB.
23 – Two consecutive MCB reads from a PLIB did not match.
24 – Alert tone command received for call on a broken PLIB.
25 – Failure command for unassigned PLIB.
26 – Invalid PLIB command from CSC.
27 – Off-hook command on unassigned PLIB.
28 – Invalid request from PLIB.
29 – Onhook command from unassigned PLIB.
2A – Digits from unassigned PLIB.

2.3.24 CSC (Central Site Controller)/ReSC (Remote Site Controller)

DEVICE NO (HEX): **0E0**

TASK ID NUMBER: **00**
TASK NAME: **Generic**

01 – CSC restart – any kind
02 – CSC restart – power fail
03 – CSC restart – lost battery-backed RAM
04 – CSC restart – test started
05 – CSC restart – no long BIN
06 – CSC restart – no short BIN
07 – CSC restart – SMT reset
08 – RCSC restart – DCB/RCSC link failure
09 – Variable ID processor started with no work to do
10 – VIDPRC started with invalid command
11 – Dynamic talkgroup pool full
12 – Invalid DRAM page selected
13 – Invalid EPROM page selected

2.3.24 CSC (Central Site Controller)/ReSC (Remote Site Controller) (Cont)

DEVICE NO (HEX): 0E0

TASK ID NUMBER: 02
TASK NAME: NXTOSW

01 – Unknown command
02 – Repeat OSW stuck due to channel in improper state
03 – Repeat OSW stuck due to incorrect reverse threads

TASK ID NUMBER: 04
TASK NAME: INTFTX

11 – No bins on INTFTX work queue
12 – Unknown command to INTFTX

TASK ID NUMBER: 06
TASK NAME: ISWOSW

01 – Unknown task command (ISW DISPATCH processor)
02 XX XX CC – Unknown ISW request
XX XX = ID
CC = Call type
03 – OSW false reference and ISW (OSW expiration processor)
04 – Individual ID not defined by the hybrid partitioning table
05 – Received a type I request with invalid ID in a mixed fleet (ID < 16)
06 XX XX – ICU reject request for a call that ISW could not find. XX XX = 16 BIT ID
07 – Received a D0 or D3 out of sequence
08 – Call assigned to channel and RIB or TIB already assigned
09 – Call assigned to channel and D4 timer already active
0A – Call assigned to channel and D5 timer already active
0B – Call assigned to channel and D6 timer already active
0C – Interconnect call counter went out of range CURICU
0D – Interconnect call counter went out of range CURSP
0E – Reserve repeater count went too low
0F – Count of non–emergency calls went negative
10 XX XX YY YY CC – Received a dual word ISW for a service not yet available
XX XX = 16 bit individual ID for first word
YY YY = 16 bit talkgroup ID for second word
CC = Call type
11 – DCB tried to assign call to control channel
12 – DCB tried to assign call to assigned channel
13 – Unit ID of selected group < > 0 in supergroup
14 – Number of reserved emergency channels went out of range
15 – 5 channel request issued to a 28 channel channel
16 – Checksum test on Normal/Tactical table failed
17 – ISW for changing Normal/Tactical state with no TCI
18 XX XX – Fleetwide emergency received.
XX XX = 16 bit ID
19 XX – Systemwide call ID received
XX = Call type
39 – Checksum test on Normal/Tactical flag table failed
40 – Illegal extended function ISW received (change in tactical state when no TCI9 is present)
41 – Received unknown ISW from the ADCB
43 XX XX – Individual ID out of range
XX XX = 16–bit individual ID
44 XX XX YY YY – Talkgroup ID out of range
XX XX = 16–bit individual ID
YY YY = 16–bit talkgroup ID
46 XX XX YY YY ZZ ZZ – Improperly marked fleetwide talkgroup
XX XX = 16–bit ID
YY YY = talkgroup ID
ZZ ZZ = fleet ID

TASK ID NUMBER: 06 (CONT)
TASK NAME: ISWOSW

47 – Invalid call type on passport busy queue
48 – SAC database lost and SAC function turned off
49 – Bad data in individual–to–talkgroup affiliation table
50 – Bad data in talk group–to–fleet affiliation database
51 – Count of regrouped members not consistent with number of regrouping bins queued up
52 – Bin found on channel table corresponding to 2nd set of patch PTT grants even though call is no longer active
53 XX XX YY YY ZZ ZZ – Fleet error for requesting fleetwide talkgroup
XX XX = 16–bit ID
YY YY = talkgroup ID
ZZ ZZ = fleet ID
54 XX XX YY YY ZZ ZZ – Type II fleet error for active fleetwide talkgroup
XX XX = 16–bit ID
YY YY = talkgroup ID
ZZ ZZ = fleet ID
55 XX XX – DRAM problem found in talk group–to–supergroup table during call processing
XX XX = start of regrouped talkgroup block
56 XX XX YY – Received request with ID type in wrong range
XX XX = 16–bit ID
YY = call type
57 – Received a data channel request on a non–data system
58 – Received a Data End–of–Call request from a unit other than the Trunked Data Controller
59 XX XX YY – Received wide area request from local console
XX XX = 16–bit ID
YY = call type
60 XX XX YY YY ZZ ZZ – Dynamically regrouping announcement talkgroup that is not setup in database
XX XX = 16–bit ID
YY YY talkgroup ID
ZZ ZZ fleet ID
61 – Ready bin not found on APC queues
62 – Time or Date ISW rejected due to gateway closed
63 CC – Unknown call type for ATA billing
CC = Call type

TASK ID NUMBER: 07
TASK NAME: CHLWRK

01 – CHLWRK started with no work
02 – Illegal RSC command received
03 – Illegal device number in RSC command
04 – Command received for inactive RSC
05 – Command received with unknown source
06 – Illegal command received
07 – Illegal device number in TSC command
08 – Command received for inactive TSC
09 XX – Pending command on deassigned channel XX (hex)
0A XX – Previous AMSS call not cleaned up for channel XX
0B – Illegal intertask command received
0C – Illegal channel address in intertask command
0D – Intertask command received out of expected sequence
0E – Call started for a call type not yet serviced
0F XX CC DD FF TT RR II II – Abnormal call end
XX = Channel number
CC = Call type
DD = D5 timer count
FF = Flags
TT = TIB status
RR = RIB status
II II = 16 bit ID

2.3.24 CSC (Central Site Controller)/ReSC (Remote Site Controller) (Cont)

DEVICE NO (HEX): 0E0

TASK ID NUMBER: 08
TASK NAME: EDMWRK

---

01 – EDMWRK started with no work to do
02 – EDMWRK started, but unknown command received
03 – Illegal device in status change command
04 – Device number out of range
05 – Set malfunction timeout to maximum to prevent Failsoft. All MALF RIBs due to illegal carrier, changed to enabled
06 – Tryed to end an AMAX call
07 – Tryed to do BSI but it was assigned
08 – Illegal device in BSI command
09 – 1st 3X command received and 1st one being held
0A – Received 2nd 3x bin and no 1st
0B – Bad data in individual–to–talkgroup affiliation table
0C LL WW SS TT – AMSS remote trunking status message
  LL = Local failsoft 40–4F reported from remote site see *REMOTE SITE GENERATED AMSS MESSAGES*
  WW = Widearea failsoft 40–4F reported from remote site ,see *REMOTE SITE GENERATED AMSS MESSAGES*
  SS = System failsoft 40–5F reported from master site, see *REMOTE AND PRIME SITE GENERATED AMSS MESSAGES*
  TT = Trunking Status
    01 – Wide Area Trunking
    02 – Local Trunking
    03 – Trunking
    04 – Wide Area Failsoft
    05 – Site Failsoft
    08 – Idle
0D – Received an alarm status when not an MCSC system type
0E – Received a site status change when the system type is a CSC
0F TT – AMSS remote site Trunking status change.
  TT = Trunking Status
    01 – Wide Area Trunking
    02 – Local Trunking
    03 – Trunking
    04 – Wide Area Failsoft
    05 – Site Failsoft
    06 – Causing failsoft
    07 – Isolated
    08 – Idle
10 – Central switched from IDLE to ACTIVE
11 – Central switched from ACTIVE TO IDLE
12 – Site status checksum error, all sites set to default
13 – Invalid site request received
14 TT = ATA Memory Status
  TT = Reason for Alarm
    01 – ATA storage space 90% full
    02 – ATA storage space 100% full
    03 – ATA read/write error
15 –
16 –
17 –
18 –
19 –
1A –
1B –
1C –
1D –
1E –
1F –
20 – Exit from failsoft
21 – Entered failsoft due to: no RSC link
22 –
23 – Entered failsoft due to: no IRB
24 – Entered failsoft due to: no TSC port
25 –
26 – Entered failsoft due to: no RIB for control
27 – Entered failsoft due to: no TIB for control
28 – Entered failsoft due to: no RIB FOR voice channel
29 – Entered failsoft due to: no TIB for voice channel
2A – entered failsoft due to: TCI reporting no TSC link
2B – Entered failsoft due to: TCI reporting no TIMI links
2C – Entered failsoft due to: no BIM for control
2D – Entered failsoft due to: no BIM for voice
2E – Entered failsoft due to: no TCI link

TASK ID NUMBER: 08 (CONT)
TASK NAME: EDMWRK

2F – Entered failsoft due to: no DCB link
30 – Entered failsoft due to: ReSC malfunction
31 – Entered failsoft due to: ReSC Composite Status Change
32 – Entered failsoft due to: Majority of Channel Failure
33 – Entered failsoft due to: No Control Channels at a Remote
34 – Entered failsoft due to: ReSC CRB malfunction
35 – Entered failsoft due to: ReSC Link failures
36 – Entered failsoft due to: all ReSC are disabled or malf
38 – Entered fail soft due to: no TCI/RSC link
39 – Entered failsoft due to: no TCI/DCB link
3A – entered failsoft due to: ReSC link malf
3B – Entered failsoft due to: no RTIB for control
3C – Entered failsoft due to: no RTIB for voice

REMOTE SITE GENERATED AMSS MESSAGES

40 – Entered failsoft due to: remote audio status bad
41 – Entered failsoft due to: remote link malf (RCSC, DCB)
42 – Entered failsoft due to: remote link malf (RCSC, RSC)
43 – Entered failsoft due to: remote link malf (RCSC, TCI)
44 – Entered failsoft due to: remote link malf (TCI,RSC)
45 – Entered failsoft due to: remote link malf (TCI read only)
46 – Entered failsoft due to: remote link malf (RCSC, TSC)
47 – Entered failsoft due to: remote TCI reporting no TIMI links
48 – Entered failsoft due to: remote IRB malfunction
49 – Entered failsoft due to: no RIB for a control channel
4A – Entered failsoft due to: no TIB FOR a control channel
4B – Entered failsoft due to: no wide area RIB for voice channel
4C – Entered failsoft due to: no wide area TIB for voice channel
4D – Entered failsoft due to: no local RIB for a voice channel
4E – Entered failsoft due to: no local TIB for a voice channel
4F – Entered failsoft due to: no local BIM for a voice channel

PRIME SITE GENERATED AMSS MESSAGES

51 – Entered failsoft due to: remote link malf (RCSC, DCB)
52 – Entered failsoft due to: prime link malf (MCSC, DCB1)
53 – Entered failsoft due to: prime link malf (MCSC, TCI)
54 – Entered failsoft due to: prime link malfunction (TCI, DCB)
55 – Entered failsoft due to: prime link malf (TCI readonly link)
56 – Entered failsoft due to: prime link malf (MCSC, DCB2)
57 – Entered failsoft due to: prime TCI reporting no TIMI links
58 – Entered failsoft due to: all remote sites are in limited mode
59 – Entered failsoft due to: no RIB for wide area voice channel at the prime
5A – Entered failsoft due to: no TIB for wide area voice channel at the prime
5B – Entered failsoft due to: no BIM for wide area voice channel at the prime

---

TASK ID NUMBER: 09
TASK NAME: LOGGER

---

01 – Dispatch busy/call length not calculated, abnormal length

---

TASK ID NUMBER: 0A
TASK NAME: USESUB

---

01 – Priority level not valid, set to default
02 – Subscriber not active or enabled
03 – Duplicate bins purged from system manager queue
04 – Invalid bin address for bin to be released to available queue
05 – Bad codeplug default password
06 – Invalid command sent to USEWRK
07 – Unsupported command sent to USEWRK
08 – Password table corrupted
09 – Invalid logon attempt
0A – SIMS priority change checksum error
0B – Invalid priority value from SIMS
0C – SAC database lost during execution of “SAC“ command

2.3.24 CSC (Central Site Controller)/ReSC (Remote Site Controller) (Cont)

DEVICE NO (HEX): **0E0**

TASK ID NUMBER: **0E**
TASK NAME: **NMIWRK**

---

01 – Time data lost
02 – Misc. parameter data lost
03 – EDMWRK status data lost
04 – LOGGER WEEKDAY parameters lost
05 – LOGGER WEEKEND parameters lost
06 – LOGGER SUMMARY data lost
07 – ISWOSW NEGS list lost
08 – A value in PARM was too low
09 PP AA AA – DRAM malfunction in SAC database
PP = DRAM page number
AA AA = address of malfunction
0A – ISR data lost on default page of DRAM
0B – ISR data lost on an alternate page of DRAM
0C – Fleet–subfleet/talk group SAC data lost
0D –
0E – SAC data lost and SAC turned off
0F – SAC defaults and status lost
10 – Passwords lost and set to default
11 – Codeplug passwords corrupted and set to null
12 – Bad DRAM found in password area. No password needed to log into system manager terminal
13 –
14 – All or some talkgroup to fleet affiliation lost
15 – All or some individual to talkgroup affiliations lost
16 – DRAM malfunction while performing affiliation error detection
17 – Dynamic regrouping table & checksum byte cleared due to checksum error
18 – Too many talkgroups set up in the prefix/sizecode table for the amount of DRAM (codeplug error)
19 – Weekday dispatch timeout table lost
1A – Weekend dispatch timeout table lost
1B – Protect table bad – Shared User Group info lost
1C – Interconnect table bad – Shared User Group info lost
1D – Dispatch table bad – Shared User Group info lost

2.3.25 Redundant Link

DEVICE NO (HEX): **EB**

TASK ID NUMBER: **00**
TASK NAME: **RDLWRK**

---

01 – Unknown command received
02 – This link has detected a DCD error
03 – No CTS on this port
04 – This link has detected a framing error
05 – This link has detected an overrun error
06 – This link has detected a parity error
07 – Link error received
08 – Link failure due to lack of receive data
09 – ECHO sync was lost on this link
0A – Receive checksum error for this link
0B – Receiver buffer overflow for this link
0C – Unknown ACIA error for this link
0D – Bad sequence number for EHL
0E – Bad response tag
0F – ACIA reset due to DCD ERRORS
10 – Sent queue overflow for this link
11 – Link enabled
12 – Unknown redundant link opcode received
13 – Bad data in individual to talkgroup affiliation database
14 – Status of link after ACB push button switch change

2.3.26 ReSC–ACB Link

DEVICE NO (HEX): **0EF**

TASK ID NUMBER: **00**
TASK NAME:

2F – Status of link after front panel change; condition shows current status

2.3.27 SIB (Site Interface Board)

DEVICE NO (HEX): **0F0–0FE**

TASK ID NUMBER: **00**
TASK NAME:

---

20 – No malfunction status
21 – Audio path status mismatch
22 – Audio control hardware unable to break audio
23 – Audio control hardware unable to break audio and audio path status mismatch
24 – Audio control hardware unable to connect audio
25 – Audio control hardware unable to connect audio and audio path status mismatch
26 – Audio control hardware unable to connect audio and audio control hardware unable to break audio
27 – Audio control hardware unable to connect audio, audio control hardware unable to break audio, and audio path status mismatch

2.3.28 RTIB (Remote Transmitter Interface Board)

DEVICE NO (HEX): **130–14B**

TASK ID NUMBER: **01**
TASK NAME: **EDM**

---

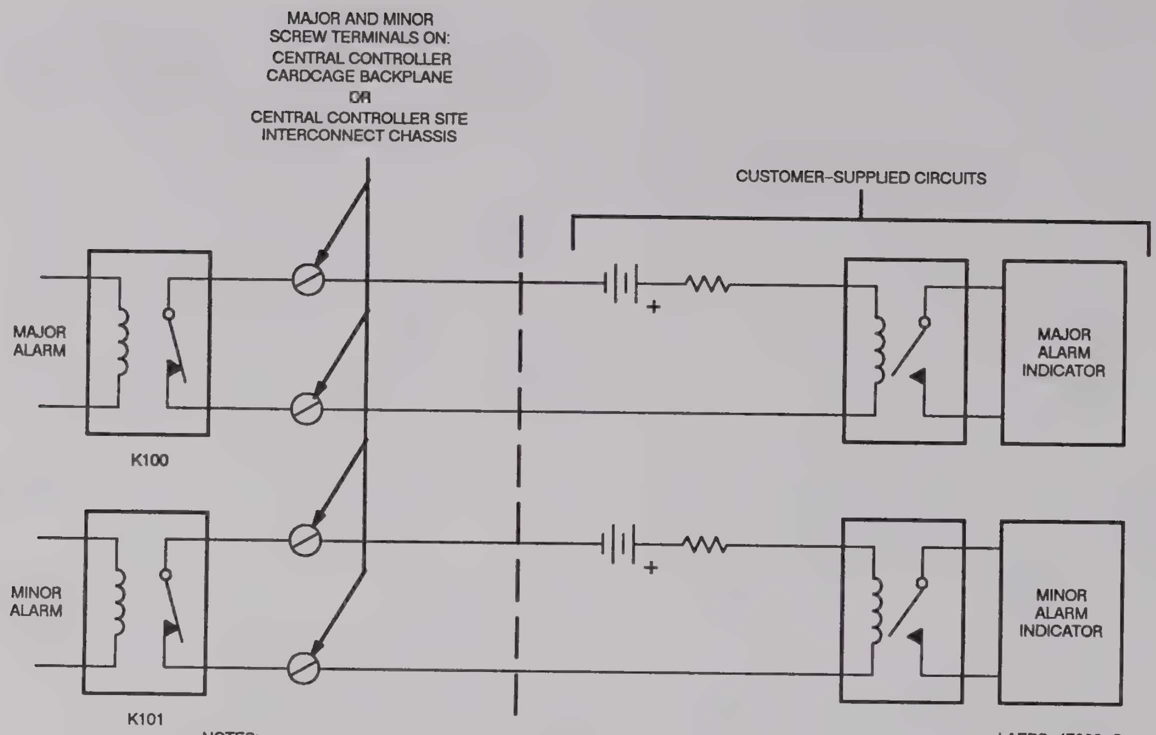
20 – Device status; condition shows current status.
27 – Malfunction due to no TSTAT during test.
28 – Malfunction due to TSTAT present when not keyed.
29 – Malfunction due to no TSTAT during call.
2A – Malfunction due to no TSTAT for control channel.
2C – Malfunction due to CRB losing lock on control channel.
2D – RIB(/RTIB) status change due to site removed from service.
2F – Front panel switch change; condition shows current status.

2.4 DIAGNOSTIC MESSAGE GLOSSARY

Refer to Table 1.

Table 1. Glossary

Acronym	Description	Acronym	Description
ACB	Asynchronous Communications Board	MCSC	Master Central Site Controller
ACIA	Asynchronous Communications Interface Adapter	MI	Main Central, Idle
ADCB	AMSS Data Concentrator Board	NEGS	Negative Suscriber Access
AMSS	Automatic Multiple Site Select	NMIWRK	Non–maskable Interrupt Work
APC	Advance Private Queue	NXTOSW	Next Outbound Signaling Word
ATA	Air–Time Accessories	OSW	Outbound Signaling Word
BA	Backup Central, Active	PARM	Parameter
BI	Backup Central, Idle	PLIB	Phone Line Interface Board
BIM	Base Interface Module	PMINTF	Prime Interface
BSI	Base Station Identifier	PTT	Push To Talk
CACB	CSC Asynchronous Communications Board	RACB	ReSC Asynchronous Communications Board
CHLPRC	Channel Processor	RCMD	Receive Command
CHLWRK	Channel Work	RCSC	Remote Central Site Controller
CLLPRC	Call Processor	RDLWRK	Receive Delay Work
CMD	Command	ReSC	Remote Site Controller
CRB	Clock Recovery Board	RMINTF	Remote Interface
CSC	Central Site Controller	RSC	Receiver Site Controller
CTS	Clear–to–Send	RSTFLG	Reset Flag
CURICU	Current ICU Count	RTIB	Remote Transmitter Interface Board
CURSP	Current Phone Count	SAB	Site Audio Board
DACB	DCB Asynchronous Communications Board	SAC	Subscriber Access Control
DCB	Data Concentrator Board	SIB	Site Interface Board
DCD	Data Carrier Detect	SIMS	*SMARTNET* Information Management System
DRAM	Dynamic RAM	SMT	System Manager Terminal
EDM	Enable/Disable Malfunction Work	TACB	TCI Asynchronous Communications Board
EDMPRC	EDM Processor	TBIM	Trunked Base Station Interface Module
EDMWRK	EDM Work	TBLACC	Table Access
EHL	Error Handling Link	TCI	Trunked Console Interface
FRF	Fast Radio Finder	TDC	Trunked Data Controller
ICU	Interconnect Unit	TIB	Transmitter Interface Board
INQWRK	In Queue Work	TIMI	Trunked I/O Multiplexed Interface
INTFRX	Receive Interface Routine	TONPRC	Tone Processor
INTFTX	Transmit Interface Routine	TRIB	Telephone Repeater Interface Board
IRB	Inbound Recovery Board	TSC	Transmitter Site Controller
ISR	Individual SAC Records	TSTAT	Transmitter Status
ISW	Inbound Signaling Word	USESUB	User Subroutine
MA	Main Central, Active	USEWRK	User Work
MALF	Malfunction	VIDPRC	Valid ID Processor
MCB	Master Control Board		


MAJOR AND MINOR
SCREW TERMINALS ON:
CENTRAL CONTROLLER
CARDCAGE BACKPLANE
OR
CENTRAL CONTROLLER SITE
INTERCONNECT CHASSIS
CUSTOMER–SUPPLIED CIRCUITS
MAJOR ALARM
K100
+
MAJOR ALARM INDICATOR
MINOR ALARM
K101
+
MINOR ALARM INDICATOR

LAEPS–47883–O

NOTES:

1. ALL RELAYS ARE SHOWN ENERGIZED (NON–ALARM CONDITION).
2. CENTRAL CONTROLLER K100 AND K101 CONTACTS RATED FOR 28 V DC @ 100 MA.

Figure 2. Typical External Alarm Connections

3. RELAY–ACTIVATED EXTERNAL ALARMS

The central controller is provided with two sets of dry–contact relay outputs labeled MAJOR ALARM and MINOR ALARM. Refer to NO TAG and to the INSTALLATION portion of the central controller instruction manual. Both sets of relay contacts are normally closed (energized), indicating a non–alarm condition. With alarm occurrence, the corresponding relay contacts open.

MAJOR ALARM relay contacts open with the following malfunctions.

- Loss of ac power to the central controller.
- Loss of one or more of the dc power voltages.
- Failure of the CSC, RSC, or TSC site controller boards or loss of communications with any of these boards.
- Failure of the IRB (inbound recovery board).
- Failsoft operation.

The MAJOR ALARM can be cleared only by setting the site controller front panel **SERVICE ENABLE** key switch to the **SERVICE** position or by resetting the site controller board.

MINOR ALARM relay contacts open with the following malfunctions.

- Voice channel transmitter failure.
- Tone detector failure on RIB (receiver interface board)
- MCB (master control board) failure or loss of MCB communications.
- ATA (air–time accumulator) has activated a minor alarm.

The MINOR ALARM is cleared when the source of the alarm is no longer present. Alarms are functional only when the site controller boards are in the RUN mode.

External alarm relay contact characteristics are:

- Maximum current rating: 100 milliamperes
- Maximum voltage rating: 28 V dc.

Motorola does not supply external alarm devices, but any suitable devices may be used as long as they operate within the specified current and voltage ratings.

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TRUNKED SYSTEM CONFIGURATION

Table 1. Standard Fleet Configurations for Type I Systems

*Fleet Type	Maximum # of Individuals/Fleet	Subfleets Per Fleet	Maximum # Fleets
A	16	3	127
A	16	3	128
B	64	7	16
B	64	7	16
C	128	7	8
C	128	7	8
D	512	15	1
D	512	15	1
Totals	**9200**	– –	**305**

1. TYPE I SYSTEMS

1.1 STANDARD FLEET CONFIGURATION

The Standard Motorola 800 MHz Trunked Radio System accommodates four types of fleet configurations, as shown in Table 1. The maximum number of each type of fleet that can be handled on one system has been standardized as indicated in the table with smaller fleet sizes predominating.

This fleet partitioning scheme makes provisions for up to 305 fleets which may comprise up to 9200 mobile units and control stations.

1.2 OPTIONAL FLEET CONFIGURATIONS

1.2.1 General

Optionally, a system may be ordered with special fleet mapping. Table 2 shows the choices for a special fleet map. In general, the larger the fleet capacity desired on the system , the fewer the fleets one is able to accommodate.

Each Type I fleet type has been given a letter to represent the type of size code (A–Q). In order to evaluate the selection of the fleet type alternatives available on any given trunked system, a weighted system is used. A maximum total of 8 points can be allocated for a single trunked system. If desired, 8 different fleet types (each one only one point in weighted value) can be chosen for the systems. One of each fleet types A–H would be an example. Otherwise, any combination, or even 8 points, all of one fleet type, can be selected.

1.2.2 System Examples

An example of utilizing the new fleet sizes is illustrated as follows:

- A city–wide system is begun with a 5–channel system for the public works department. One major department is set up as two major fleets — water and street maintenance. They each start on a 'D'–size fleet, each with 270 units.

- One year after the system was first operational, the central controller is upgraded to include dynamic regrouping capability and emergency call. Ten new repeaters are installed and both the police and fire departments, with 400 units each, begin to be phased in — each using a 'D'–size fleet. A total of 1340 units are operational.

- One of the requirements the city considers important is for all the police and fire units to be able to access an All–Call Channel. One subfleet in an 'O'–type fleet is set up with an ID capacity of 2048. Each police and fire vehicle is equipped with this fleet/subfleet access. Finally, a neighboring community is also now planning to install a trunked system. Another subfleet of the All–Call fleet is been set aside for the mutual–aid group so that any of the police or fire vehicles of either community, as required, can access that subfleet. The resulting fleet map has been established that now utilizes four 'D'–size fleets, and one 'O'–size fleet — a total of 8 weighted points.

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Table 2. Optional Type I Fleet Configurations

Size Code	Weighted Points	Fleets	Subfleets Per Fleet	Maximum Unit IDs/Fleet
*A	1	127/128	3	16
*B	1	16	7	64
*C	1	8	7	128
*D	1	1	15	512
E	1	64	3	32
F	1	32	7	32
G	1	32	3	64
H	1	16	3	128
I	1	8	3	256
J	1	4	7	256
K	1	2	15	256
M	2	1	15	1024
O	4	1	15	2048
Q	8	1	15	4096
Totals	– –	**305**	– –	**9216**
*Standard fleet type; two of each included in a standard fleet map. One A fleet type includes an unused, invalid fleet number.				

- The fleet size configuration allows for extra subfleets in the fleets so that dynamic regrouping may be created. However, there are no extra whole fleets that can be created because all fleets are used. If an 'I'–, 'J'–, or 'K'–type size code were used in place of one of the 'D'–type fleets, additional fleet capacity would become available.

One should note whenever a modification of the fleet size is required, for example, to allow more units beyond the limit of the original fleet size, code plugs need to be modified in all units in the field in order to change fleet types (and allow more capacity).

Also, when a system that has been in operation for a period of time requires a change in the fleet map, if no mobiles have been assigned within a particular size code group, the size code can be exchanged without affecting units already on the system.

2. TYPE II SYSTEMS

The Type II protocol uses a signaling word that can contain either the talk group or individual ID information, independently. The Type II protocol between the radios and the central controller specifies which ID information is to be used, and, when it is to be used.

This fleet partitioning scheme makes provisions for up to 2048 talk groups if the system has priority monitor; 4096 talk groups without priority monitor. These talk groups may comprise up to 48,000 mobile units and control stations. The Type II system configuration is shown in Table 3 and Table 4.

Up to 2048 fleets with priority monitor (4096 without) may be used in a system, without any restrictions put upon the number of talk groups per fleet, or, fleets per prefix. If desired, only one fleet may be used, comprised of all available talk groups and individual IDs. As shown in Table 3, a size code of X is used for each prefix in a Type II system.

Table 3. Type II System Prefix/Size Code Map

System Prefix	Size Code	Units/Prefix
0	X	8191
1	X	8192
2	X	8192
3	X	8192
4	X	8192
5	X	8192
6	X	8192
7	X	8191

Table 4. Type II Unit IDs allowed by prefix

System Prefix	Hexadecimal From–Thru	Decimal From–Thru
0	0001–1FFF	00001–08191
1	2000–3FFF	08192–16383
2	4000–5FFF	16384–24575
3	6000–7FFF	24576–32767
4	8000–9FFF	32768–40959
5	A000–BFFF	40960–49151
6	C000–DFFF	49152–57343
7	E000–FFFE	57344–65534

Table 5. Mixed System Prefix/Size Code Map with One Prefix Dedicated to Type II

System Prefix	Size Code	Fleets	Subfleets Per Fleet	Maximum Unit IDs
0	A	127	3	16/Fleet
1	A	128	3	16/Fleet
2	B	16	7	64/Fleet
3	B	16	7	64/Fleet
4	C	8	7	128/Fleet
5	C	8	7	128/Fleet
6	D	1	15	512/Fleet
*7	X	256	N/A	8191/Prefix
*Type II prefix — allows for up to 256 talk groups and 8191 units.				

3. MIXED SYSTEMS (TYPE I AND TYPE II)

3.1 GENERAL

Mixed systems allow Type I radios to have all basic trunking features and all Type I features when operating with other Type I radios on the system. Mixed systems also allow Type II radios to have all basic trunking features, Type I features, and Type II features with other Type II radios. In addition, mixed systems will allow Type I radios to communicate with Type II radios on the same voice channel. Mixed systems will operate at 800 MHz.

3.2 SYSTEM CONFIGURATION

In order to expand a Type I system beyond the Type I–only fleet map, there are three alternatives:

- Alternative 1 – This requires that at least one system prefix be converted to Type II. This yields up to 8192 Type II IDs (depending on the prefix used) and 256 talk group IDs that can be assigned to new Type II radios. This alternative would apply where the existing system has one size code not currently being used, or, with only a few IDs assigned. Those radios that were assigned would require either code plug changes to reassign them to other Type I size codes, or, an upgrade, if possible, to Type II software. This is the preferred method, and is shown in Table 5.
- Alternative 2 – This requires that only a portion of a system prefix be converted to Type II. That is, if one size code prefix was assigned to eight 'C' size fleets, the address space for only one 'C' fleet could be converted. This would leave seven 'C' fleets for Type I IDs. The converted fleet map space would provide 1024 Type II IDs and 32 talk group IDs. This would be useful for existing systems that have some fleets not being used. The numbers used in this example are dependant upon the size code.
- Alternative 3 – This allows any part of the total ID space to be allocated for Type II IDs, including subfleets within an existing fleet. This would be effective for existing systems with only very large, already filled with IDs. For example consider a system with only two 'O' fleets with 15 subfleets each. If one subfleet was removed from each fleet, 4095 Type II unit IDs would become available. The numbers used in this example are also dependant upon the size code.

Table 6 displays the tradeoff of Type I fleet map IDs to Type II IDs for each Type I size code.

It is recommended that new systems be set up with at least one prefix set aside for Type I talk groups and IDs. This will aid future capability of accepting roamers from other systems and at the same time allow for compatibility with some Type I–only radios.

Table 6. Type I/Type II Fleet Map Tradeoff

Gain for each FLEET converted			Gain for each SUBFLEET converted	
Size Code	**Talk Groups**	**Units**	**Talk Groups**	**Units**
A	2	64	0	16
B	16	512	2	64
C	32	1024	4	128
D	256	8192	16	512
E	4	128	1	32
F	8	256	1	32
G	8	256	2	64
H	16	512	4	128
I	32	1024	8	256
L	64	2048	8	256
K	128	4096	8	256
M	512	16384	32	1024
O	1024	32768	64	2048
Q	*	*	128	4095

*This would convert the entire fleet map to Type II only with the maximum of 2048 talk group IDs and 48,000 Unit IDs. No Type I units could be on the system.

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TRUNKED INTERCONNECT THEORY OF OPERATION

1. TRUNKED INTERCONNECT BILLING

1.1 GENERAL

Centralized Interconnect on a trunked system uses a shared line concept, which is similar to the basic trunking concept of shared channels for everyday dispatch traffic. Sharing phone lines results in a cost effective approach when utilized by many users. The BILLING software internal to the interconnect system can keep track of and compute each user's portion of the total phone bill. This part of the BILLING function is referred to as the TELCO BILLING.

The other billing function that the software performs is AIRTIME BILLING. This billing mechanism keeps track of how much voice channel airtime is used by the mobile placing or receiving a phone call and calculates a charge for each call based on the rate that the system owner wishes to charge.

Running totals for both the AIRTIME and TELCO charges are maintained internally by the interconnect system on a per mobile basis. Summary software routines exist that format the information and send it to the system owner's printer/terminal upon command.

Explanations and examples of the software commands are given in Instruction Section 68P81081E88 located behind the COMMAND FUNCTIONS & RESPONSES divider tab of this manual. Reference should be made to applicable portions of that Section as required.

This section gives an 'inside look' at how the AIRTIME and TELCO BILLING works. That is, when a call is placed, how does the interconnect system bill for that call? With this kind of basic understanding, one can better use the BILLING function and take full advantage of its versatility.

1.2 AIRTIME BILLING

1.2.1 General

The AIRTIME BILLING function can be done two ways. The system owner must choose between the FLAT and VARIABLE methods. When one method is initially chosen, the INIT routine prompts the system manager for all the parameters associated with the method. Any 'unused' parameters, such as AIRTIME RATES 2—6 when using the FLAT method, are set automatically to default values by the INIT routine. Actually, all of the internal parameters are used when a call is billed, regardless of which method was chosen. Entering a choice for the method merely tells the INIT routine what questions to prompt the system manager for and how to fill up the billing parameter table. This same approach is also used for the TELCO BILLING function.

The billing parameter table is listed with the LAIR command (paragraph 3.2 of Section 698P81081E88) and modified with the MAIR command (paragraph 3.5 of Section 698P81081E88).

1.2.2 Call Example -- Billing

The following steps illustrate what happens at the end of an interconnect call to bill for the airtime used. Again, this process is method (flat/variable) independent, which means it works the same way every time.

Mobile–to–land and land–to–mobile Individual and Subfleet calls are billed as follows:

THE CALL ENDS . . . .

1. Calculate call duration in seconds and add it to the unit record.
2. Check amount of airtime used by this mobile unit so far in the present billing period.

   If the total amount of airtime used by this unit, including this call, is not over the amount of FREE MINUTES, then do not bill for this call, but do update the total amount of air time used by this unit.

   If the total amount of airtime used is over the FREE MINUTES by an amount that is less than the dura-

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tion of this last call, then bill for the amount that is over the FREE MINUTES and update the airtime used by this unit. For example, if each mobile is allowed 30 FREE MINUTES of airtime and a particular unit has used 28 minutes of airtime so far and then makes a 3 minute call, the charges assessed for this call will be for 1 minute of airtime.

(28 + 3 = 31, 31 – 30 = 1 minute)

If the total amount of airtime used is over the FREE MINUTES amount by more than the duration of this last call, then bill only for the duration of this last call and update the airtime used by this unit. For example, for a system where 30 FREE MINUTES of airtime are allowed and a mobile has used 31 minutes of airtime and places a 3 minute call, the charges assessed will be for the full 3 minutes.

3. Determine the airtime rate ($/minute) to use:
   - from the current day of week, determine which table to use, weekday or weekend.
   - from the hour that the call as made (0 — 23), determine which rate to use (1 — 6).
4. Calculate the call charges (bill by the second)

   Airtime Charges = (call duration) X (AIRTIME RATE)
5. Add the airtime call charges to the unit record (fixed charges are added and tax is calculated at summary time.) The unit record to which airtime charges are added is the record corresponding to the land–to–mobile ID.

NOTES

1. Since the bill for each call is rounded to an increment of 1 cent, the total amount of airtime used by all the units on the system multiplied by the airtime rate (assuming that all six rates are the same) does not generally equal the dollar amount that the airtime summary shows for the entire system. This divergence is normal and represents a very small percentage of the bill (cents compared to dollars).
2. The FREE MINUTES are the number of minutes per month that the user can talk without being charged more than the MINIMUM FEE.
3. The airtime call duration is basically the amount of airtime used for the call on the voice channel to which it was assigned by the central controller. For example, in a mobile–to–land call, the 'airtime clock' starts as soon as the mobile hears dial tone, and stops when the call is ended, either by the mobile 'hanging up' or by the land party hanging up, whichever happens first. However, if the mobile can not successfully enter a valid phone number and the central controller terminates the call, the airtime billing routine does not bill for the time used.

NOTES (Cont'd.)

4. Airtime call duration in a land–to–mobile call is calculated from the time that the mobile answers until the time at which the call is ended, either by the mobile or land party hanging up, or by the call timing out, whichever is first. Unanswered land–to–mobile calls are not billed since they use no voice channel resources. The airtime billing ends when the land party hangs up or the call times out for land–to–mobile subfleet calls. The interconnect system can not detect the land party hanging up on systems with loop start phone lines.

1.2.3 Airtime Billing Period Rollover

At 12:00 A.M., on the airtime BILLING START DATE, the present period totals become the last period totals, and the present period records start over at zero. This shift is performed so that last month's bills can be referred to while they are being collected. Note that the AIRTIME BILLING START DATE can be set independently of the TELCO START DATE.

1.3 TELCO BILLING

1.3.1 General

The TELCO BILLING mechanism is designed to calculate each user's share of the monthly phone bill from the local telephone company (TELCO). Due to the complexity involved with calculating call charges for calls to area codes that are billed as 'TOLL' calls (long distance) by the phone company (i.e., calling an exchange in New York from a system in Chicago), they are not calculated, but, rather, a call record is created and stored in memory that keeps track of who called which long distance phone numbers, for how long, and at what time. Of course, such calls as these can be denied by using the proper authorization levels for the system users. A common approach is to let the mobiles direct dial any phone number for which the billing mechanism can calculate call charges, which is normally many of the exchanges in the local area code, and make the mobiles use their local telephone company credit card to call an occasional long distance number. Credit card calls are done is most areas by dialing '0' and then the area code and phone number. The billing software records all credit card calls (0+) in the long distance memory just in case the mobile can convince the operator to let the call go through without identifying their credit card number. If this happens, the system owner can match up the bill from the phone company to the long distance call summary to see who pays for that call.

The majority of billing work done internally by the interconnect system is calculating the phone charges for each call to numbers that are 'local' (approximately 98% of all calls). This, of course, is mobile-to-land calls only. The billing software allows the system owner to choose one of three possible TELCO BILLING METHODS to accomplish this. The correct choice depends on how the local TELCO assesses its call charges. Determining how the local TELCO does its billing can normally be found in a local telephone directory or by calling the phone company. The three billing methods are:

1. FLAT METHOD — The TELCO charges a flat fee for the telephone line each month and allows unlimited calling to selected exchanges. All other numbers are 'Toll', and are charged at a rate dependent on the phone number dialed, the duration of the call, and the time of day at which the call is made. The allowed exchanges under the flat rate method are entered into the interconnect system by the owner as 'free' exchanges. Calls to 'Toll' numbers are recorded in long distance memory.
2. METERED METHOD — The TELCO charges a monthly fee for the line, and charges a fixed fee (e.g., $ .25) for each call to selected exchanges. The duration of these calls is unlimited. That is, each call costs $ .25, no matter how long the call lasts. These selected exchanges are entered into the interconnect system memory by the owner as 'metered' exchanges. All other phone numbers are treated as 'Toll', and, if the mobile is authorized to dial 'Toll' numbers, the calls are recorded in long distance memory.
3. VARIABLE METHOD — The TELCO charges a fixed monthly fee for the line, as usual, and assesses charges for each call to selected exchanges based on which exchange is called and how long the call lasts. The system manager must determine the exchange rates for these variable rate exchanges from the TELCO and enter them into the interconnect memory as the VARIABLE RATE EXCHANGES. All other phone numbers are treated as 'Toll'.

Calculating the TELCO DURATION is somewhat more complicated than calculating the AIRTIME DURATION. Since the interconnect system TELCO billing function should mimic what the phone company charges for each call, close approximations for the start and stop times are sought, as well as knowing the difference between a call that really went through and one that was unanswered and, hence, no TELCO charges should be generated. The 'stop time' is easy. It is when either the mobile or land party hangs up the call. The 'start time' is a little more difficult to determine since the interconnect system is not a phone company central office with all the equipment for signaling call states between itself and, possibly, other central offices. To get around the problem of TELCO billing for unanswered or busy calls, the system manager may elect to use the answer threshold function.

1.3.2 Answer Threshold

The answer threshold is a time duration (0–60 seconds) that the system manager specifies for each phone line with the TELL P command. This time duration is the threshold that a mobile-to-land (M-L) call must be beyond before the interconnect system 'registers' the call as one that really went through and was answered at the land end. For example, if the threshold is set to 30 seconds and the time between the last digit of the phone number being entered by the mobile and the end of the call is only 20 seconds then no internal TELCO billing is processed. The called party was busy or did not answer and the mobile ended the call. The local phone company does not charge for the call and neither does the interconnect system (actually only airtime charges are assessed). Using the threshold improves the accuracy of the TELCO billing, bringing down the number of 'overcharges' for the calls that were busy or unanswered. The answer threshold has no effect on land-to-mobile calls.

1.3.3 Call Example -- TELCO BILLING

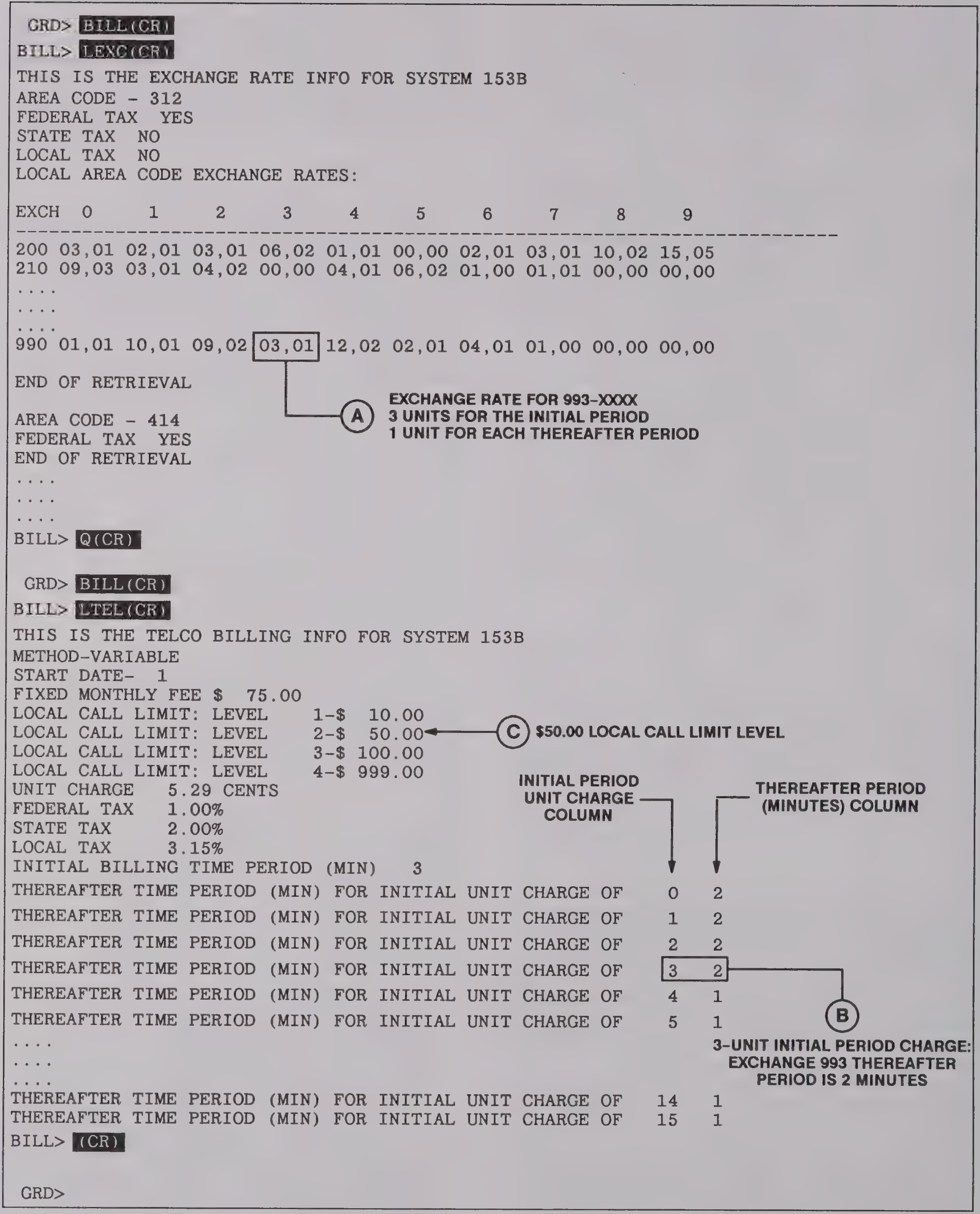
(Refer to Figure 1 .)

To understand how the TELCO BILLING works inside the interconnect system, the following example is given.

No matter what method is specified, the billing of a call is always done the same way. All of the table entries are used. The common TELCO billing parameters are listed with the LTEL command (paragraph 3.3 of Section 698P81081E88) and modified with the MTEL command (paragraph 3.6 of Section 698P81081E88). The rates to dial particular exchanges are listed with the LEXC command (paragraph 3.4 of Section 698P81081E88) and modified with the MEXC command (paragraph 3.7 of Section 698P81081E88).

THE CALL ENDS . . . .

1. If the number dialed was a toll number, a long distance call record is generated and stored in memory. Toll numbers are simply numbers for which the interconnect system does not know how to calculate call charges. They can be exchanges within the same area code; or most often, exchanges in another area code. Toll exchanges in the local area code are identified as such by the LEXC command as having an exchange rate of '15,15'. Exchanges in other area codes are assumed to be toll exchanges if they have not been entered into the system memory as a NEARBY AREA CODE EXCHANGE.
2. If the number dialed was not a toll number, then the normal process of determining the rate, multiplying



```
 GRD> BILL(CR)
BILL> LEXC(CR)
THIS IS THE EXCHANGE RATE INFO FOR SYSTEM 153B
AREA CODE - 312
FEDERAL TAX  YES
STATE TAX  NO
LOCAL TAX  NO
LOCAL AREA CODE EXCHANGE RATES:

EXCH  0     1     2     3     4     5     6     7     8     9
--------------------------------------------------------------------------
200 03,01 02,01 03,01 06,02 01,01 00,00 02,01 03,01 10,02 15,05
210 09,03 03,01 04,02 00,00 04,01 06,02 01,00 01,01 00,00 00,00
....
....
....
990 01,01 10,01 09,02 03,01 12,02 02,01 04,01 01,00 00,00 00,00

END OF RETRIEVAL

AREA CODE - 414
FEDERAL TAX  YES
END OF RETRIEVAL
....
....
....
BILL> Q(CR)

 GRD> BILL(CR)
BILL> LTEL(CR)
THIS IS THE TELCO BILLING INFO FOR SYSTEM 153B
METHOD-VARIABLE
START DATE-  1
FIXED MONTHLY FEE $  75.00
LOCAL CALL LIMIT: LEVEL    1-$  10.00
LOCAL CALL LIMIT: LEVEL    2-$  50.00
LOCAL CALL LIMIT: LEVEL    3-$ 100.00
LOCAL CALL LIMIT: LEVEL    4-$ 999.00
UNIT CHARGE   5.29 CENTS
FEDERAL TAX   1.00%
STATE TAX     2.00%
LOCAL TAX     3.15%
INITIAL BILLING TIME PERIOD (MIN)   3
THEREAFTER TIME PERIOD (MIN) FOR INITIAL UNIT CHARGE OF    0   2
THEREAFTER TIME PERIOD (MIN) FOR INITIAL UNIT CHARGE OF    1   2
THEREAFTER TIME PERIOD (MIN) FOR INITIAL UNIT CHARGE OF    2   2
THEREAFTER TIME PERIOD (MIN) FOR INITIAL UNIT CHARGE OF    3   2
THEREAFTER TIME PERIOD (MIN) FOR INITIAL UNIT CHARGE OF    4   1
THEREAFTER TIME PERIOD (MIN) FOR INITIAL UNIT CHARGE OF    5   1
....
....
....
THEREAFTER TIME PERIOD (MIN) FOR INITIAL UNIT CHARGE OF   14   1
THEREAFTER TIME PERIOD (MIN) FOR INITIAL UNIT CHARGE OF   15   1
BILL> (CR)

 GRD>
```

Ⓐ EXCHANGE RATE FOR 993-XXXX
3 UNITS FOR THE INITIAL PERIOD
1 UNIT FOR EACH THEREAFTER PERIOD

Ⓒ $50.00 LOCAL CALL LIMIT LEVEL

INITIAL PERIOD UNIT CHARGE COLUMN

THEREAFTER PERIOD (MINUTES) COLUMN

Ⓑ 3-UNIT INITIAL PERIOD CHARGE:
EXCHANGE 993 THEREAFTER
PERIOD IS 2 MINUTES

Figure 1. TELCO Call Billing Example

the rate by the call duration to get the call charges, and adding the call charges to the user's records proceeds as follows:

- Retrieve the EXCHANGE RATE from the local exchange rate table or from a nearby area code exchange rate entry. The format is XX, YY, where XX is the number of UNITS for the INITIAL BILLING PERIOD and YY is the number of UNITS for the THEREAFTER TIME PERIODS. A unit is a measure of phone service related to how long the call and how far away. Even if the local phone company does not explicitly use the Unit System, the interconnect system can be set up using the Unit System to closely approximate the way the local TELCO does their billing. Using the Unit System internally provides the versatility required to imitate several ways that the phone companies do their billing.
- The INITIAL BILLING PERIOD is the minimum amount of time, at the beginning of a call, for which call charges are calculated. Normally, the initial billing period is for 3 minutes. If the initial billing period is 3 minutes and a call is made that lasts for less than 3 minutes, the call is billed for 3 minutes. The amount of the bill, in this case is the number of units for the initial billing period as specified by the 'XX' in the exchange rate. Each call is always billed for the full initial billing period.

  If the call duration goes beyond the initial billing period, then units are assessed depending on how long the THEREAFTER TIME PERIODS are, how many were used, and how many units per THEREAFTER TIME PERIOD are to be charged. The THEREAFTER TIME PERIOD is usually 1 or 2 minutes. It depends on how many units the initial billing period costs. The initial billing cost, again, is specified as the 'XX' in the exchange rate and can range from 0 to 15. The system manager must fill in the THEREAFTER TIME PERIOD TABLE with the corresponding number of minutes. Each THEREAFTER TIME PERIOD is for each of the possible initial unit charges from 0 to 15.
- Determine the total number of units used for this call. If the phone number dialed is 991-5555, the exchange rate is seen to be 03,01 (Ⓐ in Figure 1). The thereafter time period is shown as 2 minutes for calls to exchanges that are assessed 3 units for the initial billing period (Ⓑ in Figure 1). The initial billing period is 3 minutes. So, the number of units to be charged is 3 units for the first 3 minutes; 1 unit for each 2 minute period used after the first 3 minutes. The time used is always rounded up to the next time boundary. For example, if the call lasts 4 minutes, then the charge is 3 units for the first 3 minutes and 1 units for the last minute. In this example, one THEREAFTER TIME PERIOD was used. If the call had lasted 6 minutes, then two THEREAFTER TIME PERIODS would have been used for an additional 2 units added to the initial 3 units for a total of 5 units.

  Table 7 provides several TELCO billing examples.
- Calculate the call charges knowing the total number of units used and the UNIT CHARGE. The call charges are:

  Call Charges (cents) = Units Used X Unit Charge (cents/unit)

  Add the call charges to the mobile record.
- Calculate the taxes on the call charges and add them to the mobile record, also.

  Tax = Call Charge X Tax Rate
- Increment the count of local calls by 1 in this unit record.

NOTES

1. By using the unit structure to do the billing, a rate increase from the phone company is easily handled by merely changing the UNIT CHARGE.
2. 'Free' exchanges (or those covered under the flat billing method) have exchange rates of 00,00 which always results in $0.00 being added to the mobile account at the end of the call.
3. 'Metered' exchanges show up as having an exchange rate of 01,00 which results in 1 unit being charged for the call. The unit charge, in this case, is set to equal the CHARGE PER METERED CALL.
4. If a non-zero ANSWER THRESHOLD is used, then the M-L calls must be over the threshold before they are logged. Every individual L-M call that the mobile answers generates a record. Finally, every subfleet L-M call that is assigned a channel also generates a call record.
5. LOGGING has no affect on the normal TELCO billing process. That is, a call to an exchange that adds a unit charge amount to that mobile account is not affected by the logging function generating a call record.
6. When LOGGING is used in conjunction with PBX Processing (refer to paragraph 3.14 of Section 698P81081E88), the mobile must dial at least 1 digit before a call record is generated at the end of the call.
7. The SLNG command call record output routine prints 'LAND' next to each call record that was a L-M call.

Table 7. TELCO Billing Examples

Duration	Exchange	Each Rate	Initial Units	Thereafter Units	Total Units
10 minutes	998	0,0	0	0	0
2 minutes	997	1,0	1	0	1
15 minutes	997	1,0	1	0	1
1 minute	999	4,0	4	0	4
2 minutes	996	4,1	4	0	4
8.1 minutes	996	4,1	4	6	10
4.9 minutes	992	9,2	9	4	13

1.4 MISCELLANEOUS BILLING FACTS AND FIGURES

1.4.1 General

1. All dollar amounts are internally maintained in increments of 1 cent. Call charges are, therefore, rounded to increments of a cent.

2. Time measurements are maintained internally by increments of 1 second. Airtime charges are charged by the second, based on a dollar amount per minute rate. TELCO charges are always based on call durations rounded up to the nearest minute.

3. Billing is not done for Motorola Automatic Radio Telephone Interconnect (MARTI) *Consolette* phone calls. The MARTI is always on a single fleet which is normally a single customer and the corresponding fleet. They will provide for, and pay the bill for, their own phone line. The system owner may elect to charge this MARTI customer an additional flat monthly fee for interconnect airtime use of the trunked system.

4. There is room in memory for 950 LONG DISTANCE CALL RECORDS. When they become full, no–one is allowed to make a call that would result in a long distance call record being created. Instead, an error message is sent to the system manager terminal as an alert to list and clear out the records. 'Long Distance' dialing is also turned off if any single unit accumulates 250 long distance records. 'Long Distance' calling automatically becomes active again when the records have been cleared. The duration of the long distance call is always rounded up to the nearest increment of 1 minute when the record is printed out. Airtime charges, however, for these calls are billed using the actual length to the second.

5. The billing and authorization software is currently capable of supporting a maximum of 720 mobiles. This is not to say that each interconnect system should, or can be, loaded up to that maximum number. Each system owner must watch the traffic loads, monitoring things like dispatch and interconnect busy times as summarized by the SHARED SERVICE ALGORITHM. Careful scrutiny of the SHARED SERVICE output helps the system manager decide where the number of interconnect users on the system should be leveled off.

1.4.2 Exchange Rates

1. There is always room to enter rates for all the possible exchanges in the LOCAL AREA CODE. Emergency 911 is always a 'free' exchange. Information 411 is always allowed and is billed as set–up in the exchange rate entry for exchange 411. The memory has room to enter up to 6 NEARBY AREA CODES with 800 exchanges each, or 10 NEARBY AREA CODES with 480 exchanges, on the average, entered for each.

2. Calls to TOLL FREE '800' numbers are always treated as free and do not appear in the Long Distance Call Summaries.

3. Calls just to the operator (0) are not allowed, since the mobile could have the operator dial any number in the world and the system could not track it since the mobile is not dialing. Emergencies can be handled by calling 411 or 555–1212, both of which will be to an operator who may be able to directly assist by forwarding the call to the authorities or at least be able to give the mobile the correct emergency number to call, depending on where the mobile is located. Some areas have the 911 emergency number in service, which is even better.

2. TRUNKED INTERCONNECT AUTHORIZATION

2.1 GENERAL

The AUTHORIZATION function not only constrains which mobiles may place and receive interconnect calls, but also restricts which phone numbers may be dialed. Typically, the authorization parameters are set up to allow the users to direct dial any phone number that is treated as a local call by the phone company. That is, phone numbers that can be dialed that add up call charges in a running total (or add nothing if it is a really close exchange that is free), and does not show up as a separate line per call on the phone bill.

Toll calls are those numbers that are listed on the phone company bill on an individual basis, like calling New York from Chicago. A toll number can be inside or outside the local area code. Likewise, non–toll local calls can be inside or outside the local area code. Generally, non–toll exchanges are within the local area code and clustered around the radio system site.

Sometimes, when an interconnect system is near a border between two (or more) area codes, it is not uncommon to dial a phone number in the NEARBY AREA CODE and have it treated by the phone company as a local call for billing purposes. For example, a mobile on a system that is in area code 815 can dial a few 'free' numbers into the bordering area code 708. That same mobile could call, if so authorized, certain exchanges in his own area code, 815, that are far away and are treated as toll exchanges.

All exchanges are assumed to be toll exchanges by the BILLING and AUTHORIZATION functions if nothing has been entered into the interconnect system memory about them (exchange rate parameters).

2.2 AUTHORIZATION PARAMETERS

2.2.1 General

The EDIT example in Figure 2 shows typical sets of parameters.The land–to–mobile ID is the 6–digit number that a land party would enter, once they have called the interconnect unit, to ring a mobile.

2.2.2 Local Call Limit Level

This parameter can be set to a number between 1 and 4. The four limit level choices are set to dollar limits in the BILL INIT or BILL MTEL commands. A limit level number (1–4) is assigned to each mobile and, hence, the dollar threshold is assigned indirectly. This dollar limit threshold is the maximum amount of TELCO charges that a mobile user can accumulate before being denied access to the interconnect.

For example, fleet 600, unit 100 in Figure 2 has a local call limit level of 2. See © of Figure 1 for the correspondence between limit Level 2 and the corresponding dollar amount. Once that unit makes $50.00 worth of local phone calls, it will not receive dial tone. When the calling is shut down for this unit, it are still able to receive incoming land–to–mobile calls. The call limits provide a throttle on the amount of TELCO bill liability that a mobile accumulates.

2.2.3 Authorization Level

This parameter is probably the most important since it provides the basic constraint on what phone numbers the mobile is allowed to dial. There are five levels to choose from. The actual phone numbers that can be dialed at each level depends on what has been entered into the interconnect memory in the way of exchange rates for the local and, possibly, nearby area codes. The five levels are defined as follows:

LEVEL 1	No inbound or outbound phone calls are allowed. Midnight rollover TELCO fixed fees are not added. This level can be used to 'freeze' a mobile's billing records until the end of the month so it appears in the summaries with the rest of the mobiles. The mobile could be deleted from the list at that time.
LEVEL 2	Only calls to numbers that are 'free' are allowed. These are exchanges that have an exchange rate of 00,00. The numbers do not have to be within the local area code. They can ,just as well be in a nearby area code. Any exchange that has been entered as free can be dialed with Level 2.
LEVEL 3	Includes Level 2 free call authorization and, in addition, calls to any phone number that has had a 'non–toll exchange rate entered for it. For example, calls to exchanges with rates such as 03,01 or 09,02 or 01,00 are allowed. Calls to toll exchanges are not allowed. Toll exchanges are denoted as such by an exchange rate of 15,15 (or, if it is in another area code, by simply not being in the exchange list). Level 3 is the most commonly used since it allows the mobile to direct–dial any exchange for which the billing function can calculate and access TELCO charges.
LEVEL 4	Every exchange in the local area code can be dialed. Every exchange in each of the entered (if any) nearby area codes can be dialed.
LEVEL 5	CARTE BLANCHE — Any exchange in any area code can be dialed.

Calls to Information, 411 are always allowed for Levels 2–5. Calls to Information, 555–1212 are allowed if the mobile can access exchange 555. Toll Free 800 numbers are allowed at each of the levels (2–5). If a '1' is required in front of any numbers, '1+' dialing has to be enabled. Phone company credit card calling is allowed at any level (2–5) if '0+' dialing is enabled for that mobile.

```
 GRD> AUTH(CR)

AUTH> EDIT I757349(CR)  <———————— INDIVIDUAL UNIT ID (TYPE II)
    L-M ACCESS NUMBER IS 757349<——— LAND-TO-MOBILE ID
 1. HALF DUPLEX
 2. LOCAL CALL LIMIT LEVEL 4
 3. AUTHORIZATION LEVEL 4
 4. 0+ DIALING ENABLED
 5. 1+ DIALING ENABLED
 6. CUSTOMER GROUP NUMBER 017
 ENTER # OF PARAMETER TO CHANGE OR Q TO QUIT: 2(CR)
 ENTER LOCAL LIMIT LEVEL (1-4): 2(CR)
 ENTER # OF PARAMETER TO CHANGE OR Q TO QUIT: Q(CR)

AUTH> EDIT 600 100(CR)  <———————— FLEET/INDIVIDUAL ID (TYPE I)
    L-M ACCESS NUMBER IS 052480
 1. HALF DUPLEX
 2. LOCAL CALL LIMIT LEVEL 2
 3. AUTHORIZATION LEVEL 3
 4. 0+ DIALING ENABLED
 5. 1+ DIALING ENABLED
 ENTER # OF PARAMETER TO CHANGE OR Q TO QUIT: 2(CR)
 ENTER LOCAL LIMIT LEVEL (1-4): 2(CR)
 ENTER # OF PARAMETER TO CHANGE OR Q TO QUIT: Q(CR)

 AUTH> Q(CR)
ACTIVE USER LIST

 GRD>
```

Figure 2. EDIT Example

2.2.4 Half Duplex/Full Duplex

This parameter indicates that the mobile is a HALF DUPLEX type. This means that the radio can either transmit or receive, at a given time, and not do both at once.

The other alternative is FULL DUPLEX. A full duplex radio can transmit and receive at the same time making the conversation take place just like a regular phone call.

The interconnect system must know when the mobile is a full duplex type so that the repeat audio path in the actual repeater can be turned off. This is so that the mobile does not 'talk back to itself' at full volume. There is some sidetone, however, due to the hybrid in the Telephone Repeater Interface Board (TRIB). The sidetone is present, just like any landline phone.

2.2.5 0+ Dialing Enabled

This parameter can restrict '0+' or credit card calling. If enabled, the mobile is allowed to dial any number using his TELCO credit card. For example, one could dial 0-976-1212 to make a call to a toll number within the local area code, or 0-312-976-1212 to call a toll number in another area code. The call is billed directly to the customer's own TELCO account. The interconnect system generates no TELCO charges, but, of course, does generate airtime charges. Actually, a long distance call record is generated for each '0+' call to keep track of these calls

Incidentally, other types of long distance credit card calling (like *MCI*) can be done just as a simple local call. The mobile can send DTMF through to enter their credit card number, etc. The '0+' parameter is not used to restrict these *MCI*-type calls.

2.2.6 1+ Dialing Enabled

The '1+' dialing parameter, shown enabled in the Figure 2 examples, specifies whether or not the mobile is allowed to dial phone numbers that require a '1' in front of them; usually meaning that the number is a toll call. Unlike the '0+' parameter, the '1+' parameter being enabled does not mean that the mobile is automatically authorized to dial any phone number after the '1'. For example, if a mobile on a Chicago system has '1+' dialing enabled, but only has authorization level 3, that mobile can not dial 1-212-976-1212 to call New York. An authorization level of 5 would be required.

NOTE

If toll free 800 numbers require a '1' preceding the '800', then '1+' dialing has to be enabled if the mobile is to be allowed to call these numbers. Also, see the discussion on PRE-DIGITS (paragraph) concerning digits that must be entered before the actual phone number is dialed.

2.3 CALL EXAMPLES

The following paragraphs describe what happens, as far as the Authorization Procedure, during a land-to-mobile call (L-M) or mobile-to-land call (M-L).

2.3.1 Land-to-Mobile Calls

There are two types of L-M calls:

1. **Individual** — Where the land party can call an individual mobile.
2. **Subfleet** — Where the land party can call a subfleet of mobiles.

An individual L-M call is placed as follows:

1. The land party phones the interconnect system.
2. The interconnect system answers after about 2 rings and a 'go-ahead' beep is given.
3. The land party enters (on a DTMF instrument) the L-M ID for the mobile, e.g., 757349.
4. The authorization process converts that L-M ID into a trunked ID (fleet and individual) to see if that mobile is a valid unit on the authorization list. In addition, the mobile must have an authorization level of 2 or above in order to be called.
5. If the mobile is on and within range of the system, it starts to ring. This is indicated to the land party by a 'slow ring'. If the mobile is out of range, turned off, or if there are no interconnect channels available, the land party hears 'fast ringing' for about 30 seconds and the interconnect system tries to 'find' the mobiles.
6. The mobile answers the call and the conversation takes place.
7. The call ends and the airtime used is billed to the mobile unit corresponding to the L-M ID.

A subfleet L-M call is placed as follows:

1. The land party phones the interconnect system and waits for the go-ahead beep to enter the L-M ID for that subfleet.
2. If an interconnect channel is available, the land party hears the trunked 'talk-permit' tone (just like a mobile hears on a quick-key) indicating that a communications path is set up from the land line to that entire subfleet. The conversation now takes place.
3. The call is ended either by the call timing out or the land party hanging up.
4. When the call ends, the airtime charges are assessed and added to the account associated with the L-M ID that the land party entered.

If the mobile, associated with the L-M ID, is already involved in an interconnect call, the land party immediately hears a 'fast busy' followed by the interconnect system hanging up on them. The same 'fast busy' is heard if 1), the L-M ID does not correspond to a mobile (an unassigned L-M ID), 2) the mobile does not have an authorization level equal to or greater than 2, or 3) the AUTHORIZATION STATUS is INACTIVE (turned off).

2.3.2 Mobile-To-Land Calls

There are several different call types that the interconnect system is capable of processing. During the dialing phase of the phone number, digits entered by the mobile are echoed to the phone line. (Actually, they are regenerated in DTMF or PULSE DIAL form, whichever is specified in the TELL P command.)

All '0+' credit card calls, however, are forced to pulse dial so that the mobile is un-keyed and receiving after entering the last digit, in time to listen for either the 'TELCO' beep tone to enter their credit card number or an operator to come on-line and request their card number. A single '0' is not echoed if it is the first digit (0+ call). It is sent to the phone company when the second digit is entered by the mobile. This prevents the operator from being dialed directly by just entering a '0'.

The normal call types processed are shown in Table 8.

Table 8. Normal Call Types

Digit Sequence	Description
NNX-XXXX	7-Digit Call
1-NNX-XXXX	1 + 7-Digit Call (probably toll)
0-NNX-XXXX	0 + 7-Digit Credit Card Call
NXX-NXX-XXXX	10-Digit Call (probably toll)
1-NXX-NXX-XXXX	1 + 10-Digit Call (probably toll)
0-NXX-NXX-XXXX	0 + 10-Digit Credit Card Call
411	Information
1-411	Information
911	Emergency
1-911	Emergency
800-NXX-XXXX	Toll-free
1-800-NXX-XXXX	Toll-free

2.4 PRE-DIGIT PROCESSING

Some area codes must use exchanges that have a 0 or 1 as the second digit (N0X,N1X exchanges). The normal digit processing in the interconnect system does allow the dialing of these seven digit exchanges since the 0 or 1 in the second digit makes the first three digits look like an area code being dialed. The processing mechanism therefore tries to collect ten digits (i.e., NXX–NXX–XXXX) before completing the call.

There is a way to tell the digit processing software that the local area code uses N0X and N1X exchanges and that these call types should be allowed. To 'turn on' this special processing, simply set the exchange rate for exchange 300 to something other than toll (which is 15,15). Then, the software allows the X0X and X1X exchanges to be dialed. With this special processing enabled, call types processed are shown Table 9.

Table 9. Normal Call Types

Digit Sequence	Description
NXX–XXXX	Local 7–Digit Call
0–NXX–XXXX	0 + 7–Digit Credit Card Call
1–NXX–NXX–XXXX	1 + 10–Digit Call
0–NXX–NXX–XXXX	0 + 10–Digit Call
411	Information
1–411	Information
911	Emergency
1–911	Emergency
1–800–NXX–XXXX	Toll–free

Note: With predigit processing enabled, 1 + 10 digits is the only way to direct dial another area code and 1 + 7 digit calls are not allowed. Credit card calls can be either 0 + 7 digits or 0 + 10 digits. 0 + 7 digit calls go through a 10–second timeout after completion of dialing. This allows checking for the 8th digit of a 0 + 10 digit call.

In some areas, a special sequence of numbers must be dialed first to gain access to certain long distance networks. The interconnect system is capable of handling five (5) such pre–digit sequences . Each sequence can be up to five digits long. Pre–digits are specified in the AUTH P command and allow their use on a system–wide basis by all of the interconnect users. After a pre–digit sequence has been entered by the mobile, the next digit following the sequence is treated as the first digit of a phone number just like any other call. In other words, the interconnect system expects a number like one of the call types in Table 8 or Table 9 .

The pre–digit sequence facility is not intended to be used to allow dialing on a private PBX type phone system where, for example, one must dial a '9' to get an 'outside' dial tone. If the interconnect system was tied to such a phone line and a '9' was typed in as a pre–digit, then calls such as 9–XXX–XXXX may work. However, the mobile does not hear the second dial tone after the '9'. This is so because the actual phone line audio is not connected to the voice channel to which the mobile is assigned until all the digits are collected, processed through Authorization, and regenerated on the phone line.

PRE–DIGIT EXAMPLE

A particular phone company requires that the sequence '123' be entered to gain access to the long distance network to dial 10–digit numbers. In this case , the digits '123' would be entered as a sequence in the PRE–DIGIT TABLE by the system manager. Dialing long distance would be done as follows:

123–NXX–NXX–XXXX

2.5 PBX PROCESSING

Private systems, or those connected to a PBX, may elect to use the PBX processing in the interconnect system. This special processing allows a mobile to dial any phone number that is made up of any length of digits. PBX systems usually take between 4 and 11 digits to complete the call. The mobile must be on the Authorization list, as usual, and have an authorization level of at least 2. The phone lines must be DTMF compatible since PBX processing 'cuts–through' the audio from the mobile to the phone line right away in the beginning of the call.

The mobile DTMF digits go directly to the phone line to do the dialing. The PBX processing mechanism in the interconnect terminal does not try to collect a certain number of digits and echo them to the line as in normal processing. Instead, PBX processing lets the mobile directly dial any phone number but monitors what is being dialed.

The way that the system monitors the dialed numbers is quite versatile. For example, the system manager can have the dialed digits for both land–to–mobile as well as mobile–to–land call recorded into long distance call storage using the logging function described in paragraph 1.3.

Another way to track PBX–type calls is to set the exchange rate for exchange 200 to one of three choices. Every PBX processed call will default to doing TELCO billing using the exchange rate for #200. This is an important difference between PBX and the normal call processing.

Using exchange rate 200 works as follows:

1. Toll – set the rate to 15,15 to record each phone number dialed in each mobile–to–land call. If logging is turned off, no records of land–to–mobile calls are kept. This is the normal choice since L–M calls do not use up call record space (limited to 950 records) which can be used for the more important M–L calls.
2. METERED – Set the rate to 01,00 to simply count the number of M–L calls made by each mobile and not record the phone number dialed. Since the rate is 1,0 a unit charge is added to the TELCO account for each call.

3. FREE – Set the rate to 00,00 to count only the number of M–L calls placed by each mobile and not record the phone number dialed. The count is listed with the BILL STEL command.

In addition to using exchange rate 200 as mentioned above, logging can be turned on to record the phone numbers being dialed. For example, setting the exchange rate 200 to FREE (00,00) and turning LOGGING on results in a call record being generated for each M–L and L–M call, as well as a count of the number of M–L calls being kept and listed with the STEL command.

2.6 NORMAL DIGIT PROCESSING

A mobile–to–land call, using normal processing is placed as follows:

1. The user activates the interconnect switch on the mobile. If the mobile 1) is on the Authorization List, 2) is authorized for at least level 2, and 3) has not gone beyond the local call limit and if there is an interconnect channel available, dial tone is heard. Otherwise, the mobile hears an out–of–range tone or a busy tone, specifically, for the case when there is no channel available. The dial tone heard is actually generated by the interconnect system and is not coming from the telephone company.
2. The mobile dials the telephone number just as it would be dialed at the interconnect system site. If the user is not authorized to call that number, the user hears a 'fast busy' followed by the interconnect system dropping their call. Being unauthorized to make the call can be caused by any one of several things. For example, 1) if a mobile has an authorization level of 3 and tries to call a 10–digit long distance number, the call is terminated or 2), if the mobile tries to dial 0–976–1000 and is not enabled for '0+' dialing, the call is terminated. There are many other possibilities.
3. After the mobile dials a valid, authorized phone number, the TELCO phone line audio is connected to the voice channel and the conversation takes place.
4. The call is ended by the land party hanging up, the mobile disengaging from the interconnect mode, or by the call timing out. The time–out is an overall call duration timer and is controlled by the SHARED SERVICE ALGORITHM in the central controller.

2.7 AUTHORIZATION LIST NOTES

The system manager must enter the trunked mobile IDs into the AUTHORIZATION LIST that are to receive interconnect service. A preceding discussion (paragraph 2.2.2) explains each of the parameter choices.

When a mobile is added to the list, the Authorization software automatically assigns a land–to–mobile ID. This L–M ID assignments start at ????? and are incremented from there. If a mobile is deleted from the list, that L–M ID is the next to be assigned when another mobile is added later. The general rule is to reassign the most recently deleted L–M ID first, and then start back on IDs that are not assigned yet. Figure 3 shows L–M ID assignments.

In order for the interconnect system to make sure of the Authorization List, the AUTHORIZATION STATUS must be ACTIVE. The STATUS command in AUTH is used to activate or deactivate the Authorization function. So the system manager must ACTIVATE the list after typing it into the system. If the Authorization List is not activated, only 7–digit mobile–to–land calls are allowed. No airtime or TELCO charges are assessed for these calls when Authorization is turned off.

```
 GRD> AUTH(CR)
AUTH> ADD I757349(CR)
 HALF DUPLEX (Y/N): Y(CR)
 ENTER LOCAL LIMIT LEVEL (1-4): 1(CR)
 ENTER AUTHORIZATION STATUS LEVEL (1-5): 2(CR)
 ENABLE 0+ DIALING (Y/N)? Y(CR)
 ENABLE 1+ DIALING (Y/N)? Y(CR)
 ENTER CUSTOMER GROUP: 103(CR)
    L-M ACCESS NUMBER IS 757349

AUTH> ADD 600 100(CR)
 HALF DUPLEX (Y/N): N(CR)
 ENTER LOCAL LIMIT LEVEL (1-4): 2(CR)
 ENTER AUTHORIZATION STATUS LEVEL (1-5): 2(CR)
 ENABLE 0+ DIALING (Y/N)? Y(CR)
 ENABLE 1+ DIALING (Y/N)? N(CR)
    L-M ACCESS NUMBER IS 052480

AUTH> ADD I757360*(CR)
 ENTER CUSTOMER GROUP: 104(CR)
    L-M ACCESS NUMBER IS 757360

AUTH> DEL 600 100(CR)
    L-M ACCESS NUMBER IS 052480
 DELETE FLEET  # 600  UNIT # 100 (Y/N)? Y(CR)
 UNIT DELETED

AUTH> ADD T803587(CR)
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Figure 3. L–M ID Assignments Example

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USER QUESTIONNAIRE

To the User of This Instruction Manual:

Motorola is engaged in a continuous program of improving its instruction literature. We believe that you can aid us in this program, so that we in turn can better help you service our equipment. To foster these aims, would you please answer the following questions:

SCHEMATIC DIAGRAMS AND CABLING DIAGRAMS

1. ☐ Are accurate and easy to follow
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3. ☐ Contain major errors
4. ☐ Are difficult to follow

If you have checked any box except 1, please tell us what schematic diagrams, or portions thereof, were at fault, or enter other comments.*

____

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68P85901D80-L

TEXT

1. ☐ Easy to follow — helps to service equipment
2. ☐ Would like more information on*

____

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3. ☐ Some instruction sections are too long or superfluous such as*

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AVAILABLE BACKGROUND REFERENCE PUBLICATIONS

Seven reference publications are available to provide background information needed to service some of the newer Motorola products more effectively. The information in these publications is not duplicated in our instruction manuals. To obtain your free copy, check the ones you want and return this self-mailer to us.

Check item desired:

☐	**Basic Logic Circuit Guide** Describes the basic logic circuits used in Motorola Communications digital equipment and the logic notational scheme used in our instruction manuals.	68P81105E88
☐	**"Digital Private-Line" Binary-Coded Squelch** Contains fundamentals of "Digital Private-Line" system operation, circuit operation and servicing techniques.	68P81106E83
☐	**Safe Handling of CMOS Integrated Circuit Devices** Describes special handling techniques needed to prevent irrepairable damage from static charges encountered with normal handling of CMOS devices.	68P81106E84
☐	**Reducing Noise Interference in Mobile Two-Way Radio Installations** Defines the major sources of noise encountered in a mobile radio installation and suggests methods of remedying them.	68P81109E33
☐	**Anti-Skid Braking Precautions** Provides installation suggestions and a detailed checkout procedure for installation of mobile radios in vehicles with anti-skid braking systems.	68P81109E34
☐	**Removal and Replacement of Chip Components on Circuit Boards** Contains general information and repair procedures relative to chip-type (leadless) components.	68P81113E77
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